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(54) Title: CAPSAICIN RECEPTOR LIGANDS

(57) Abstract: Disclosed are diaryl piperazines and related compounds. These compounds are selective modulators of capsaicin receptors, including human capsaicin receptors, that are, therefore, useful in the treatment of a chronic and acute pain conditions, itch and urinary incontinence. Methods of treatment of such disorders and well as packaged pharmaceutical compositions are also provided. Compounds of the invention are also useful as probes for the localization of capsaicin receptors and as standards in assays for capsaicin receptor binding and capsaicin receptor mediated cation conductance. Methods of using the compounds in receptor localization studies are given.

## CAPSAICIN RECEPTOR LIGANDS

## Field of the Invention

This invention relates compounds that bind with high selectivity and high affinity to Vanilloid Receptors, especially Type I Vanilloid Receptors, also known as capsaicin receptors or VR1 Receptors. In an important aspect the invention provides capsaicin receptor, preferably human VR1 receptor, antagonists that are not capsaicin analogs (e.g., they do not contain a phenyl ring with two oxygen atoms bound to two adjacent ring carbons), are free of agonist activity, and exhibit an unprecedented level of affinity for the VR1 receptor. In another aspect, the invention provides aryl piperazines and related compounds that act as VR1 receptor ligands. In addition, this invention relates to such VR1 receptor ligands, high affinity antagonists and pharmaceutical compositions comprising such compounds and to the use of such compounds in treatment of diseases and other health-related conditions. Additionally this invention relates to the use of aryl piperazines and related compounds as tool for the analysis of VR1 receptors and as probes for the quantitative measurement and localization of VR1 receptors in cell and tissue samples.

## Background

The sensation of pain can be triggered by any number of physical or chemical stimuli. In mammals, the peripheral terminals of a group of specialized small diameter sensory neurons, termed "nociceptors" mediate this response to a potentially harmful stimulus.

In efforts to discover better analgesics for the treatment of both acute and chronic pain, and to develop treatments for various neuropathic pain states, considerable research has been

focused on the molecular mechanism of nociception. The response to heat, low extracellular pH (acidity), or capsaicin (the compound responsible for the hotness of hot peppers) is characterized by the persistent activation of nociceptors. It 5 has been shown that both heat and capsaicin are capable of activating dorsal root ganglion and trigeminal ganglion neurons via an influx of cations. Additionally, moderately acidic conditions produce this response and can also potentiate the response of nociceptors to heat and capsaicin.

10 Capsaicin responses in isolated sensory neurons show dose-dependence and are also evoked by structural analogues of capsaicin that share a common vanilloid moiety. The term vanilloid receptor (VR) was coined to describe the neuronal membrane recognition site for capsaicin and such related 15 irritant compounds. It was postulated that the VR is a nonselective cation channel with a preference for calcium. In 1989, resiniferatoxin (RTX), a natural product of certain *Euphorbia* plants, was recognized as an ultrapotent VR agonist. Specific binding of <sup>3</sup> H RTX provided the first unequivocal 20 proof for the existence of a vanilloid receptor. The capsaicin response is competitively inhibited (and thereby antagonized) by another capsaicin analog, capsazepine and is also inhibited by the non-selective cation channel blocker ruthenium red. These antagonists bind to VR with no more than moderate 25 affinity (i.e., with  $K_i$  values of no lower than 140  $\mu$ M).

Interest in characterizing VRs led to the cloning of a functional rat capsaicin receptor (VR1), from a rat dorsal root ganglion cDNA library. A human version of VR1 has also been described, and the term VR1 is used herein to refer to either 30 or both.

The capsaicin receptor's channel opens in response to elevated temperatures (higher than about 45°C). Capsaicin and related compounds, as well as protons are stimuli that lower the threshold channel opening, so that in the presence of any 5 of these stimuli the capsaicin receptor can be opened even at room temperature.

Opening of the capsaicin receptor channel is followed by the release of inflammatory peptides from neurons expressing the receptor and other nearby neurons, increasing the pain 10 response. After initial activation by capsaicin the capsaicin receptor undergoes a rapid desensitization, possibly via phosphorylation of intracellular sites of the receptor.

Capsaicin and related VR1 agonist vanilloid compounds have enjoyed long pharmaceutical use as topical anaesthetics. While 15 such compounds initially cause a strong burning sensation, receptor desensitization provides pain relief.

Localization of the capsaicin receptor in the dorsal root ganglion established this receptor as a leading target for analgesic discovery. Most currently marketed analgesic 20 compounds act centrally, and often have side effects.

Analgesic compounds that act peripherally are desirable for treating acute and chronic pain more effectively and with fewer side effects. Thus, compounds that interact with the capsaicin receptors, particularly antagonists of this receptor, which 25 would not elicit the initial painful sensation of currently marketed capsaicin containing compounds, are desirable for the treatment of chronic and acute pain, itch, and urinary incontinence.

#### Description of Related Art

30 The vanilloid compounds capsaicin and Resiniferatoxin (RTX) act as potent and specific agonists of the capsaicin

receptor. Capsazepine (which contains a phenyl ring with two oxygen atoms bound to two adjacent ring carbons and is therefore a capsaicin analog) acts as a moderate affinity competitive capsaicin receptor antagonist. Iodo-RTX is a 5 capsaicin analog that has recently been reported to act as a high affinity antagonist. The inorganic dye, Ruthenium red, also antagonizes capsaicin responses of the receptor, albeit as a non-selective cation channel blocker. For an extensive review of vanilloid receptor ligands see Szallasi and Blumberg, 10 (Pharmacological Reviews (1999) 51(3): 159-211).

#### Summary of the Invention

This invention relates to VR1 receptor ligands, particularly VR1 receptor antagonists, and methods of using VR1 receptor antagonists for the treatment of neuropathic pain, 15 peripheral-nerve-mediated pain, and pain, inflammatory and broncho-constriction symptoms resulting from exposure to capsaicin-receptor-activating stimuli such as capsaicin and tear gas.

In one aspect the invention provides novel chemical 20 compounds that act as capsaicin receptor modulatory agents, some of which exhibit antagonist potency greater than that of any previously described VR1 receptor antagonist. Compounds that act as capsaicin receptor antagonists and bind to capsaicin (preferably human VR1) receptors with  $K_i$  values of 25 less than 100 $\mu$ M, as measured by a capsaicin receptor binding assay, such as the assay given by Example 10, or that inhibit capsaicin activity in an assay for determination of capsaicin receptor antagonist effects (Example 11) with EC<sub>50</sub> values of less than or equal to 100 $\mu$ M, are referred to herein as potent 30 capsaicin receptor antagonists; such compounds that bind or antagonize with  $K_i$  or EC<sub>50</sub> values of less than or equal to 10 $\mu$ M

are referred to herein as highly potent capsaicin receptor antagonists.

In an additional aspect, the invention provides methods of using the potent capsaicin receptor antagonist compounds of the invention for the treatment of symptoms resulting from exposure to painful capsaicin receptor activating stimuli. In particular, the invention provides methods of treating subjects who have been exposed to capsaicin or have been burnt by heat, light, tear gas, or acid exposure, the methods comprising administering to such subjects an effective amount of a potent capsaicin receptor antagonist, preferably a highly potent (high potency) capsaicin receptor antagonist, so that the subject's symptoms of pain or sensitivity are reduced. Preferred compounds of the invention provide pain relief without loss of consciousness, and preferably without sedation, in such subjects that is equal to or greater than the degree of pain relief that can be provided to such subjects by morphine without loss of consciousness. Highly preferred compounds provide such pain relief while causing only transient (i.e., lasting for no more than one half the time that pain relief lasts) or no sedation (see Example 16 for sedation assay). Subjects or patients referred to herein may be humans or non-human mammals including domestic companion animals (pets) and livestock animals, as discussed more fully below.

In yet another aspect the invention provides methods of treating of neuropathic pain based on the unexpected finding that capsaicin receptor antagonists can alleviate such pain.

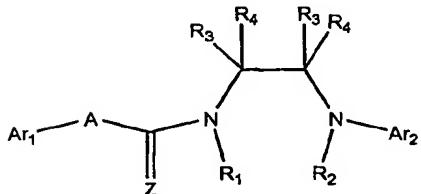
This invention also provides aryl piperazines and related compounds that bind with high affinity and high selectivity to capsaicin receptors, including human capsaicin receptors, also known as VR1 receptors.

Thus, the invention provides novel compounds of Formula I, Formula II, Formula III, Formula IV, Formula V, Formula VI, or Formula VII, Formula VIII, Formula IX and Formulae A-F shown below (the "compounds of the invention," hereinafter Formulae 5 I-IX and Formulae A-F), and pharmaceutical compositions comprising compounds of Formulae I-IX and Formulae A-F.

The invention further comprises methods of treating patients suffering from certain diseases or conditions, especially those involving pain or urinary incontinence, with 10 an amount of a compound Formulae I-IX and Formulae A-F that is effective to improve the symptoms (e.g., reduce pain or reduce the frequency of urinary incontinence) of the disease or condition being treated.

Additionally this invention relates to the use of the 15 compounds of the invention as reagents, standards, and probes for measurement, characterization and localization of capsaicin receptors, particularly VR1 receptors (e.g., in cells or tissues.

Accordingly, a broad aspect of the invention is directed 20 to compounds of Formula I:



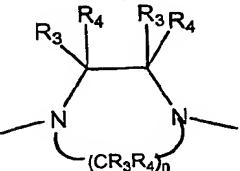
Formula I

or the pharmaceutically acceptable salts thereof, 25 wherein:  
A is chosen from O, S, NR<sub>A</sub>, CR<sub>B</sub>R<sub>B</sub>', NR<sub>A</sub>CR<sub>B</sub>R<sub>B</sub>', CR<sub>B</sub>R<sub>B</sub>'NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub>, R<sub>B</sub>, and R<sub>B</sub>' are independently selected at each occurrence from hydrogen or alkyl;

Z is oxygen or sulfur;

R<sub>1</sub> and R<sub>2</sub> independently represent hydrogen or lower alkyl; or

R<sub>1</sub> and R<sub>2</sub> are taken together to form a 5 to 8 membered nitrogen containing ring of the formula:



wherein n is 1, 2, or 3;

R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted alkyl;

10        optionally substituted alkenyl; optionally substituted alkynyl; optionally substituted alkoxy; optionally substituted mono or dialkylamino; optionally substituted alkylthio; optionally substituted alkyl ketone; optionally substituted alkylester; optionally substituted alkylsulfinyl; optionally substituted alkylsulfonyl;

15        optionally substituted mono- or di-alkylcarboxamide; optionally substituted -S(O)<sub>n</sub>NHalkyl; optionally substituted -S(O)<sub>n</sub>N(alkyl)(alkyl); optionally substituted -NHC(=O)alkyl; optionally substituted -

20        NC(=O)(alkyl)(alkyl); optionally substituted -NHS(O)<sub>n</sub>alkyl; optionally substituted -NS(O)<sub>n</sub>(alkyl)(alkyl); optionally substituted saturated or partially unsaturated heterocycloalkyl of from 5 to 8 atoms, which saturated or partially unsaturated heterocycloalkyl contains 1, 2, or 3

25        heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; or optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least

one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S;

or any two

R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form

5 an optionally substituted aryl ring; a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is optionally substituted; or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is optionally substituted and contains 10 1, 2, or 3 heteroatoms selected from N, O, and S; and

Ar<sub>1</sub> and Ar<sub>2</sub> are the same or different and independently represent optionally substituted cycloalkyl; an optionally substituted heterocycloalkyl ring of from 5 to 8 atoms,

15 which heterocycloalkyl ring contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; or optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 20 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S, and

n is independently chosen at each occurrence from 0, 1, and 2.

In specific embodiments of the invention R<sub>1</sub> and R<sub>2</sub> are 25 joined to form a 5 to 7-membered heterocycloalkyl ring, e.g. R<sub>1</sub> and R<sub>2</sub> may be joined to form a piperazine ring. This 5 to 7-membered heterocycloalkyl ring is preferably unsubstituted or substituted at one or two positions with a C<sub>1-6</sub> alkyl group, such as methyl or ethyl. The variable "Z" is preferably oxygen and 30 the variable "A" is generally NH, CH=CH, or CH<sub>2</sub>NH. Ar<sub>1</sub> and Ar<sub>2</sub> are preferably optionally substituted phenyl or optionally

substituted pyridyl; optionally substituted 2-pyridyl is preferred for Ar<sub>2</sub>. Substituents that may occur on Ar<sub>1</sub> and Ar<sub>2</sub> include, but are not limited to, butyl, isopropyl, trifluoromethyl, nitro, methyl, and halogen. Substitution at 5 the 4 position of Ar<sub>1</sub> (when Ar<sub>1</sub> is phenyl or pyridyl) and substitution at the 3 position of Ar<sub>2</sub> (when Ar<sub>2</sub> is phenyl or pyridyl) are described in specific embodiments of the invention.

Detailed Description of the Invention  
10 The invention is particularly directed to compounds of Formula I, in which R<sub>1</sub> and R<sub>2</sub> independently represent hydrogen or lower alkyl, e.g., C<sub>1-6</sub> alkyl. Such compound will be referred to as compounds of Formula IA.

15 Preferred compounds and pharmaceutically acceptable salts of Formula IA are those wherein:

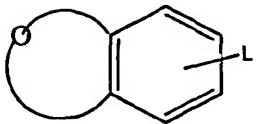
R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, haloalkyl, haloalkoxy, hydroxy, amino, alkyl substituted with 0-2 R<sub>6</sub>, alkenyl substituted with 0-2 R<sub>6</sub>; alkynyl substituted with 0-2 R<sub>6</sub>; alkoxy substituted with 0-2 R<sub>6</sub>, -NH(alkyl) substituted with 0-2 R<sub>6</sub>, -N(alkyl)(alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

20 or any two

25 R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an aryl ring substituted with 0-3 R<sub>6</sub>, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is substituted with 0-2 R<sub>6</sub>, or a saturated, partially unsaturated, or aromatic 30 heterocyclic ring of from 5 to 8 members, which

heterocyclic ring is substituted with 0-2  $R_6$  and contains 1, 2, or 3 heteroatoms selected from N, O, and S; and  $Ar_1$  and  $Ar_2$  may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl, 5 piperidinyl, piperazinyl, phenyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, 10 benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl, each of which is optionally mono-, di-, or trisubstituted with  $R_5$ ; or

$Ar_1$  and  $Ar_2$  may be the same or different and represent a 15 bicyclic oxygen-containing group of the formula:



optionally mono-, di-, or trisubstituted with  $R_5$ , where L represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the 20 bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

$R_5$  is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, haloalkyl, 25 haloalkoxy, hydroxy, amino, alkyl substituted with 0-2  $R_6$ , alkenyl substituted with 0-2  $R_6$ , alkynyl substituted with 0-2  $R_6$ , alkoxy substituted with 0-2  $R_6$ , -NH(alkyl) substituted with 0-2  $R_6$ , -N(alkyl)(alkyl) where each alkyl is independently substituted with 0-2  $R_6$ , -XR<sub>7</sub>, and Y;

$R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano, alkyl, alkoxy, -NH(alkyl), -N(alkyl)(alkyl), -S(O)<sub>n</sub>(alkyl), haloalkyl, haloalkoxy, CO(alkyl), CONH(alkyl), CON(alkyl<sub>1</sub>)(alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, -XR<sub>7</sub>, and Y;

5  $X$  is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>8</sub>-, -C(=O)-, -C(=O)O-, -C(=O)NH-, -C(=O)NR<sub>8</sub>-, -S(O)<sub>n</sub>NH-, -S(O)<sub>n</sub>NR<sub>8</sub>-, NHC(=O)-, -NR<sub>8</sub>C(=O)-, -NHS(O)<sub>n</sub>-, and -NR<sub>8</sub>S(O)<sub>n</sub>-;

10  $R_7$  and  $R_8$  are independently selected at each occurrence from hydrogen, and

15 straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(alkyl), -N(alkyl)C(O)(alkyl), -NHS(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>NH(alkyl), -S(O)<sub>n</sub>N(alkyl<sub>3</sub>)(alkyl<sub>4</sub>) where alkyl<sub>3</sub> and alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

20  $Y$  and  $Y'$  are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further

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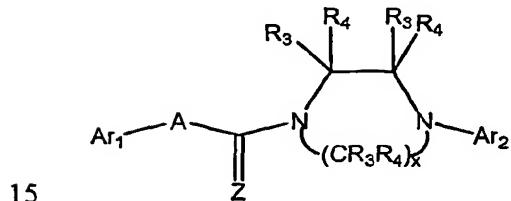
substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, alkyl, alkoxy, haloalkyl, haloalkoxy, mono- or dialkylamino, and alkylthio;

5 wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and

n is independently chosen at each occurrence from 0, 1, and 2. Such compounds and pharmaceutically acceptable salts thereof,

10 will be referred to as compounds of Formula IB.

The invention is further directed to compounds of Formula II



Formula III

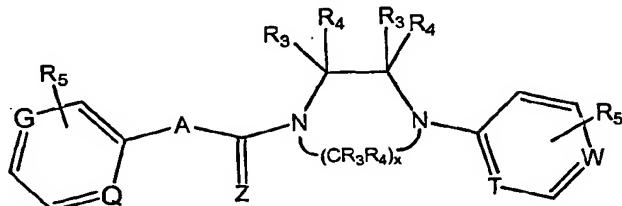
and the pharmaceutically acceptable salts thereof, wherein:  
 A, Z, R<sub>3</sub>, R<sub>4</sub> are as defined for Formula I or for Formula IB;  
 Ar<sub>1</sub> and Ar<sub>2</sub> are as defined for Formula I or for formula IB;  
 20 and  
 x is 1 or 3.

Preferred compounds and salts of Formula II are those in which .

25 R<sub>A</sub>, R<sub>B</sub>, and R<sub>B'</sub> (which are contained in the definition of A) are independently selected at each occurrence from hydrogen or C<sub>1</sub>-alkyl.

Other preferred compounds salts of Formula II are those in which Z is oxygen, and those in which Z is oxygen and A is NH.

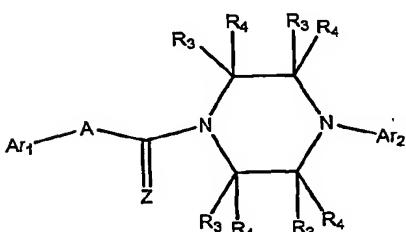
The invention is further directed to compounds of Formula 5 III



Formula III

and the pharmaceutically acceptable salts thereof, wherein:  
 10 G, Q, T, and W are the same or different and represent N, CH,  
 or CR<sub>5</sub>, where R<sub>5</sub> is as defined for Formula IB;  
 R<sub>A</sub>, R<sub>B</sub>, and R<sub>B'</sub> are independently selected at each occurrence  
 from hydrogen or C<sub>1-6</sub>alkyl;  
 Z is oxygen or sulfur;  
 15 R<sub>3</sub> and R<sub>4</sub> are as defined for Formula I or for Formula IB; and  
 x is 1 or 3.

The invention also included compounds of Formula IV



Formula IV

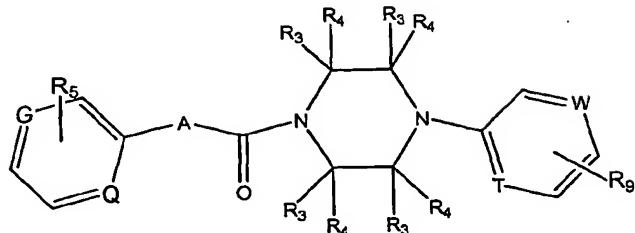
and the pharmaceutically acceptable salts thereof, wherein:  
 20 Z is S or O (preferably O);  
 A, R<sub>3</sub>, and R<sub>4</sub> is as defined for Formula I or Formula IB;

Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl, piperidinyl, piperazinyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, 5 isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl; 10 wherein Ar<sub>1</sub> is optionally mono-, di-, or trisubstituted with R<sub>5</sub>, and Ar<sub>2</sub> is optionally mono-, di-, or trisubstituted with R<sub>9</sub>; or 15 Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and represent a bicyclic oxygen-containing group as described for Formula IB,

R<sub>5</sub> is independently selected at each occurrence from the group consisting of cyano, nitro, haloalkyl, haloalkoxy, hydroxy, amino, alkyl substituted with 0-2 R<sub>6</sub>, alkenyl substituted with 0-2 R<sub>6</sub>, alkynyl substituted with 0-2 R<sub>6</sub>, 20 alkoxy substituted with 0-2 R<sub>6</sub>, -NH(alkyl) substituted with 0-2 R<sub>6</sub>, -N(alkyl)(alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

R<sub>9</sub> is independently selected at each occurrence from the group consisting of cyano, nitro, haloalkoxy, hydroxy, amino, 25 alkyl substituted with 0-2 R<sub>6</sub>, alkenyl substituted with 0-2 R<sub>6</sub>, alkynyl substituted with 0-2 R<sub>6</sub>, alkoxy substituted with 0-2 R<sub>6</sub>, -NH(alkyl) substituted with 0-2 R<sub>6</sub>, -N(alkyl)(alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y; and 30 R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, X, Y and Y' are as defined for Formula IB.

Another embodiment of the invention is directed to compounds of Formula V



Formula V

5 and the pharmaceutically acceptable salt thereof, wherein:

G, Q, T, and W are the same or different and are selected from the group consisting of N, CH, and CR<sub>5</sub>, wherein T or W or both is N;

10 A, R<sub>3</sub>, and R<sub>4</sub> are as defined for Formula I or for Formula IB (preferably A is -CH=CH-, -CH<sub>2</sub>NH, NH, and R<sub>3</sub> and R<sub>4</sub> are hydrogen or C<sub>1-6</sub> alkyl);

Z is oxygen or sulfur (preferably oxygen);

15 R<sub>5</sub> represents 1 to 3 substituents and is independently selected at each occurrence from the group consisting of cyano, hydroxy, amino, C<sub>3-6</sub> alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>3-6</sub> alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

20 R<sub>9</sub> represents 0 to 3 substituents and is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>3-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl)

substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, X, Y, and Y' are as defined for Formula IB.

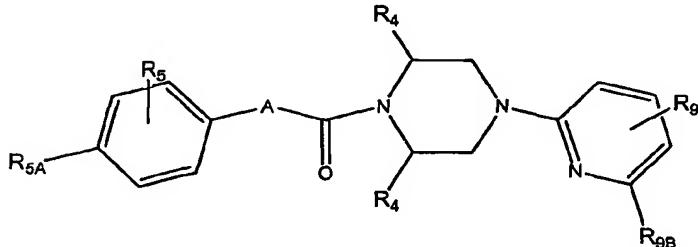
5

The invention is particularly directed to compounds and salts of Formula V wherein G and Q are selected from the group consisting of CH and CR<sub>5</sub>.

10 The invention is also directed to compounds and salts of Formula V wherein G, Q, and W are independently selected at each occurrence from the group consisting of CH and CR<sub>5</sub>; and T is N.

15 For compounds of Formula V, particularly preferred, R<sub>6</sub> substituents are halogen, hydroxy, C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkoxy, -NH(C<sub>1-4</sub>alkyl), and -N(C<sub>1-4</sub> alkyl)(C<sub>1-4</sub> alkyl).

Still another embodiment of the invention is directed of compounds of Formula VI



Formula VI

20 and the pharmaceutically acceptable salts thereof, wherein: A is selected from the group consisting of NH, -CH=CH-, and CH<sub>2</sub>NH;

R<sub>4</sub> is independently chosen from hydrogen and C<sub>1-4</sub> alkyl;

R<sub>5</sub> represents 0 to 2 substituents and is independently chosen at 25 each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl

substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>;

5 R<sub>9</sub> represents 0 to 2 substituents and is independently chosen at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>;

10 R<sub>5A</sub> is independently selected from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), and

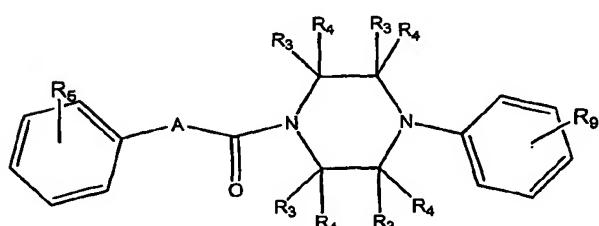
-N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl);

15 R<sub>9B</sub> is independently selected from the group consisting of halogen, nitro, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl); and

20 R<sub>6</sub> is independently selected at each occurrence the group consisting of halogen, hydroxy, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub>alkyl), and -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl).

25

The invention is also directed to compounds of Formula VII



Formula VII

and the pharmaceutically acceptable salts thereof, wherein:

A, R<sub>3</sub>, and R<sub>4</sub> are as defined for Formula I or for Formula IB;

R<sub>5</sub> is independently selected at each occurrence from the group

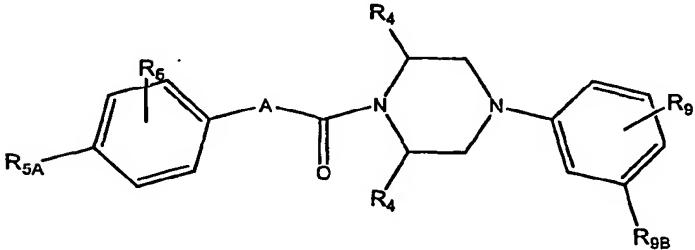
5 consisting of cyano, nitro, haloalkyl, haloalkoxy, C<sub>1-6</sub> alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub> alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub> alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub> alkyl)(C<sub>1-6</sub> alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

10 R<sub>9</sub> represents 0-3 substituents and is independently selected at each occurrence from the group consisting of bromo, -haloalkyl, -haloalkoxy, hydroxy, C<sub>2-6</sub>-alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>2-6</sub> alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>2-6</sub> alkyl)(C<sub>2-6</sub> alkyl) where each C<sub>2-6</sub> alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

15 R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, X, Y, and Y' are as defined for Formula IB.

20 Preferred compounds and salts of Formula VII include those wherein A is selected from NH, -CH=CH-, and CH<sub>2</sub>NH; and R<sub>6</sub> is independently selected at each occurrence from the group consisting of halogen, hydroxy, C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkoxy, -NH(C<sub>1-4</sub> alkyl), and -N(C<sub>1-4</sub> alkyl)(C<sub>1-4</sub> alkyl).

25 The invention includes compounds of Formula VIII

Formula VIII

and the pharmaceutically acceptable salts thereof, wherein:  
A is selected from the group consisting of NH, -CH=CH-, and  
CH<sub>2</sub>NH (NH is preferred);

5 R<sub>4</sub> is independently selected at each occurrence from hydrogen  
and C<sub>1-4</sub>alkyl;

R<sub>5</sub> represents 0 to 2 substituents independently selected at each  
occurrence from the group consisting of halogen, cyano,  
nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>  
alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with  
10 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy  
substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2  
R<sub>6</sub>, and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is  
independently substituted with 0-2 R<sub>6</sub>;

15 R<sub>9</sub> represents 0 to 2 substituents and is independently selected  
at each occurrence from the group consisting of halogen,  
cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy,  
amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl  
substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2  
20 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl)  
substituted with 0-2 R<sub>6</sub>, and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where  
each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>;

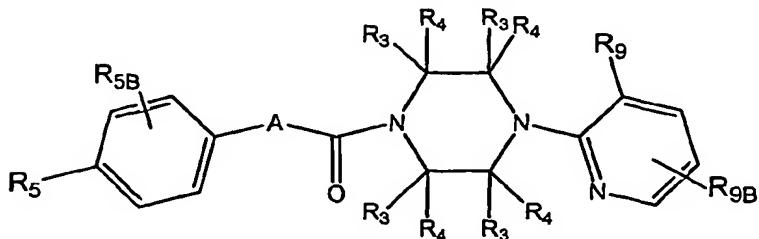
R<sub>5A</sub> is independently selected from the group consisting of  
halogen, cyano, nitro, trifluoromethyl, trifluoromethoxy,  
25 hydroxy, amino, C<sub>1-6</sub> alkyl, C<sub>1-6</sub> alkoxy, -NH(C<sub>1-6</sub> alkyl), and  
-N(C<sub>1-6</sub> alkyl)(C<sub>1-C6</sub> alkyl);

R<sub>9B</sub> is independently selected from the group consisting of  
trifluoromethoxy, hydroxy, C<sub>2-6</sub> alkyl, C<sub>2-6</sub> alkoxy, -NH(C<sub>2-6</sub>  
alkyl), and -N(C<sub>2-6</sub> alkyl)(C<sub>2-6</sub> alkyl); and

$R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy,  $C_{1-4}$  alkyl,  $C_{1-4}$  alkoxy,  $-NH(C_{1-4}$  alkyl), and  $-N(C_{1-4}$  alkyl) ( $C_{1-4}$  alkyl).

5 Preferred compound of Formula VIII are those wherein one of  $R_4$  is hydrogen and the other is methyl.

A particularly preferred embodiment of the invention includes compounds of Formula IX



10 Formula IX

and the pharmaceutically acceptable salts thereof, wherein:

$A$ ,  $R_3$ , and  $R_4$  are as defined for Formula I or for Formula IB;

$R_5$  is selected from the group consisting of bromo, fluoro, iodo, halo( $C_{1-6}$ )alkyl, halo( $C_{3-6}$ )alkoxy,  $C_{3-6}$ alkyl substituted with

15 0-3  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-3  $R_6$ ,  $C_{2-6}$ alkynyl substituted with 0-3  $R_6$ ,  $C_{3-6}$ alkoxy substituted with 0-2  $R_6$ , ( $C_{3-8}$ cycloalkyl) $C_{1-4}$ alkyl,  $-NH(C_{1-6}$ alkyl) substituted with 0-2  $R_6$ ,  $-N(C_{1-6}$ alkyl) ( $C_{1-6}$ alkyl) where each  $C_{1-6}$ alkyl is substituted with 0-2  $R_6$ ,  $Y$ ,  $-(C=O)Y$ ,  $-(CH_2)Y$ , and

20  $-(CH(CN))Y$ ;

$R_9$  is selected from the group consisting of halogen, cyano,  $-N(SO_2C_{1-6}$ alkyl) ( $SO_2C_{1-6}$ alkyl),  $-SO_2NH_2$ , halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy,  $C_{1-6}$ alkyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ,  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ ,  $-NH(C_{1-6}$ alkyl) substituted with 0-2  $R_6$ ,

25  $-(CH_2)Y$ , and  $-(CH(CN))Y$ .

-N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is substituted with 0-2 R<sub>6</sub>;

R<sub>5B</sub> and R<sub>9B</sub> each represent from 0 to 2 substituents and are independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>alkyl), halo(C<sub>1-6</sub>alkoxy), hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, (C<sub>3-8</sub>cycloalkyl)C<sub>1-4</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>, and Y; and any two

R<sub>5</sub> and R<sub>5B</sub> bound to adjacent atoms may be joined to form a C<sub>3-8</sub>cycloalkyl group or a heterocycloalkyl group, each of which is optionally substituted by from 1 to 5 substituents independently chosen from cyano, halogen, hydroxy, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl), halo(C<sub>1-4</sub>alkyl), and halo(C<sub>1-4</sub>alkoxy), wherein the heterocycloalkyl group consists of from 4 to 8 atoms and contains 1, 2, or 3 heteroatoms selected from N, O, and S; and

R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, X, Y, and Y' are as defined for Formula IB.

Preferred compounds and salts of Formula IX are those wherein A is O or NR<sub>A</sub>, wherein R<sub>A</sub> is hydrogen or methyl.

More preferred compounds and salts of Formula IX are those wherein

A is O or NR<sub>A</sub>, wherein R<sub>A</sub> is hydrogen or methyl; and R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo(C<sub>1-6</sub>alkyl), halo(C<sub>1-6</sub>alkoxy), hydroxy, amino, C<sub>1-6</sub>alkyl,

$C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}alkyl)$ , and  $-N(C_{1-6}alkyl)(C_{1-6}alkyl)$ .

Other preferred compounds and salts of Formula IX are  
5 those wherein:

A is O or  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

$R_4$  is independently chosen at each occurrence from the group  
consisting of hydrogen, halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}alkyl)$ , and  $-N(C_{1-6}alkyl)(C_{1-6}alkyl)$ .

Still more preferred compounds and salts of Formula IX are  
those wherein

15 A is O,  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

$R_4$  is independently chosen at each occurrence from hydrogen and  
 $C_{1-6}$ alkyl.

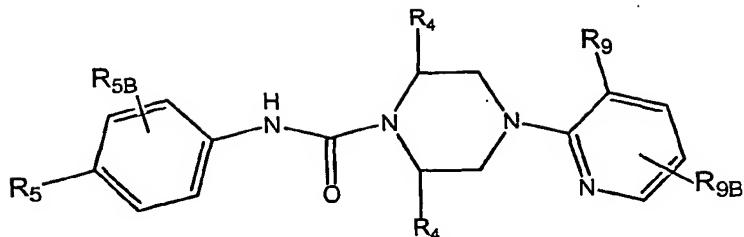
Another group of preferred compounds and salts of Formula  
20 IX is the group wherein

A is  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

$R_4$  is independently chosen at each occurrence from hydrogen,  
halo( $C_{1-3}$ )alkyl, and  $C_{1-6}$ alkyl, but more preferably  $R_4$  is  
25 chosen from hydrogen and  $C_{1-4}$  alkyl.

A particular class of compounds of Formula IX is  
represented by Formula IX-A



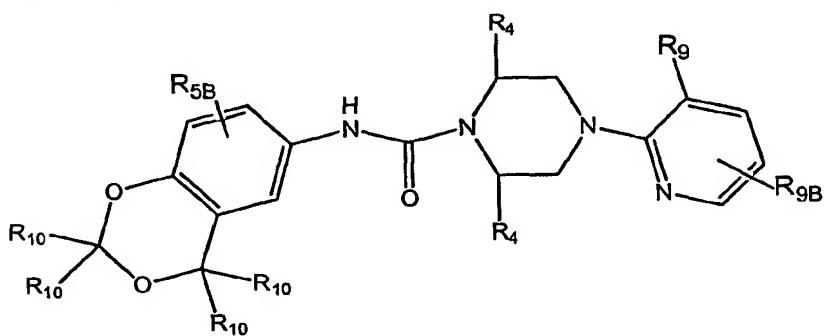
and the pharmaceutically acceptable salts thereof, wherein:

R<sub>5</sub>, R<sub>5B</sub>, R<sub>9</sub>, and R<sub>9B</sub> are as defined for Formula IX; and

R<sub>4</sub> is independently chosen at each occurrence from hydrogen and

5 C<sub>1-4</sub>alkyl.

Another class of compounds of Formula IX is represented by  
Formula IX-B:



10 Formula IX-B

and the pharmaceutically acceptable salts thereof, wherein:

R<sub>5B</sub> and R<sub>9B</sub> are independently chosen from hydrogen, halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

15 R<sub>10</sub> is independently chosen at each occurrence from hydrogen, halogen, and C<sub>1-4</sub> alkyl.

Preferred compounds and salts of Formula IX-B are those wherein R<sub>9</sub> is selected from the group consisting of halogen, 20 cyano, -N(SO<sub>2</sub>CH<sub>3</sub>)<sub>2</sub>, -SO<sub>2</sub>NH<sub>2</sub>, halo(C<sub>1-3</sub>)alkyl, C<sub>1-3</sub>alkoxy, -NH(C<sub>1-3</sub>alkyl), and -N(C<sub>1-3</sub>alkyl)(C<sub>1-3</sub>alkyl).

Other preferred compounds and salts of Formula IX-A and Formula IX-B are those wherein  $R_{5B}$  and  $R_{9B}$  are independently chosen from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl,  
5 halo( $C_{1-2}$ )alkoxy, amino,  
 $C_{1-4}$ alkyl, and  $C_{1-2}$ alkoxy.

Still other preferred compounds and salts of Formula IX-A and Formula IX-B are those wherein:

$R_{5B}$  represents 0 or 1 substituents chosen from halogen, cyano,  
10 nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, amino,  $C_{1-4}$ alkyl, and  $C_{1-2}$ alkoxy; and

$R_{9B}$  represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, and  $C_{1-2}$ alkyl, and  $C_{1-2}$ alkoxy.

15 The invention is further directed to compounds and salts of Formula IX-A and IX-B, wherein:

$R_9$  is selected from the group consisting of halogen, cyano,  $-N(SO_2CH_3)_2$ ,  $-SO_2NH_2$ , halo( $C_{1-3}$ )alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}alkyl)$ , and  $-N(C_{1-3}alkyl)(C_{1-3}alkyl)$ ;

20  $R_{5B}$  represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, amino,  $C_{1-4}$ alkyl, and  $C_{1-2}$ alkoxy; and

$R_{9B}$  represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, and  $C_{1-2}$ alkyl, and  $C_{1-2}$ alkoxy.

25

For Formula IX-A, preferred substituents are

$R_5$  is selected from the group consisting of bromo, fluoro, iodo, halo( $C_{1-6}$ )alkyl, halo( $C_{3-6}$ )alkoxy,  $C_{3-6}$ alkyl substituted with 0-3  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-3  $R_6$ ,  $Y$ ,  $-(C=O)Y$ ,  $-(CH_2)Y$ , and  $-(CH(CN))Y$ ;

R<sub>9</sub> is selected from the group consisting of halogen, cyano, -N(SO<sub>2</sub>CH<sub>3</sub>)<sub>2</sub>, -SO<sub>2</sub>NH<sub>2</sub>, halo(C<sub>1-2</sub>)alkyl,

C<sub>1-3</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl);

R<sub>5B</sub> represents 0 or 1 substituents chosen from halogen, cyano, 5 nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

R<sub>9B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, and C<sub>1-2</sub>alkyl, and C<sub>1-2</sub>alkoxy.

Particularly preferred definitions of R<sub>6</sub> for compounds and 10 salts of this class are cyano, halogen, hydroxy, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub>alkyl), and -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl) and Y; where Y is independently selected at each occurrence from C<sub>3-8</sub> cycloalkyl, piperidinyl, piperazinyl, tetrahydropyranyl, dihydropyranyl, morpholinyl, thiomorpholinyl, phenyl, 15 pyridyl, pyrazinyl, pyrimidinyl, thiazolyl, thienyl, and imidazolyl, each of which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, mono- or di(C<sub>1-4</sub>)alkylamino, and C<sub>1-4</sub>alkylthio.

Particularly preferred definitions of R<sub>9</sub> and R<sub>9B</sub> for compounds of Formula IX-A are:

R<sub>9</sub> is cyano, trifluoromethyl, chloro, or iodo; and

25 R<sub>9B</sub> is hydrogen.

Particularly preferred definitions of R<sub>5</sub> for compounds of Formula IX-A are isopropyl, t-butyl, 2-butyl, trifluoromethyl, cyclopentyl, cyclohexyl, and 30 heptafluoropropyl.

The invention is particularly directed to compounds and pharmaceutically acceptable salts of Formula IB, Formula II, Formula III, Formula IV, Formula V, Formula VII and Formula IX in which:

5  $R_A$ ,  $R_B$ , and  $R_B'$  are independently selected at each occurrence from hydrogen and  $C_{1-6}$ alkyl; for the variables  $R_3$ ,  $R_4$ , and  $R_5$  haloalkyl is halo( $C_{1-6}$ )alkyl, i.e. a haloalkyl group having from 1 to 6 carbon atoms and from 1 to maximum allowable number of halogen substituents on those carbon atoms,

10 haloalkoxy is halo( $C_{1-6}$ )alkoxy; alkyl is  $C_{1-6}$ alkyl, alkenyl is  $C_{2-6}$ alkenyl; alkynyl is  $C_{2-6}$ alkynyl; alkoxy is  $C_{1-6}$ alkoxy,  $-NH(alkyl)$  is  $-NH(C_{1-6}alkyl)$ , and  $-N(alkyl)(alkyl)$  is  $-N(C_{1-6}alkyl)(C_{1-6}alkyl)$ ,

15 for the variables  $R_6$ ,  $R_7$ ,  $R_8$ ,  $Y$  and  $Y'$  alkyl is  $C_{1-4}$ alkyl, alkoxy (or  $-O(alkyl)$ ) is  $C_{1-4}$ alkoxy (or  $-O(C_{1-4}alkyl)$ ),  $-NHalkyl$

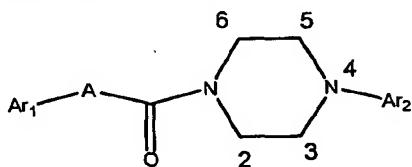
(or monoalkylamino) is  $-NH(C_{1-4}alkyl)$  (or mono( $C_{1-4}$ alkyl)amino),  $-N(alkyl)(alkyl)$  (also dialkylamino) is  $-N(C_{1-4}alkyl)(C_{1-4}alkyl)$  (also di( $C_{1-4}$ alkyl)amino),  $-S(O)_nalkyl$  is  $-S(O)_n(C_{1-4}alkyl)$ , haloalkyl is halo( $C_{1-4}$ )alkyl, haloalkoxy is halo( $C_{1-4}$ )alkoxy,  $-CO(alkyl)$  is  $-CO(C_{1-4}alkyl)$ ,

20  $-CONH(alkyl)$  is  $-CONH(C_{1-4}alkyl)$ , and  $-CON(alkyl)(alkyl)$  is  $-CON(C_{1-4}alkyl_1)(C_{1-4}alkyl_2)$ ;  $-NHC(O)(alkyl)$  is  $-NHC(O)(C_{1-4}alkyl)$ ,  $-N(alkyl)C(O)(alkyl)$  is  $-N(C_{1-4}alkyl)C(O)(alkyl)$ ,  $-NHS(O)_n(alkyl)$  is  $-NHS(O)_n(C_{1-4}alkyl)$ ,  $-S(O)_nNH(C_{1-4}alkyl)$ ,

25  $-S(O)_nN(alkyl)(alkyl)$  is  $-S(O)_nN(C_{1-4}alkyl)(C_{1-4}alkyl)$ ;

and alkylthio is  $C_{1-4}$ alkylthio.

Preferred compounds and salts of Formula V, Formula VI, Formula VII and Formula IX are those wherein  $R_3$  and  $R_4$  are independently selected at each occurrence from the group consisting of hydrogen and  $C_{1-6}$  alkyl. More preferred compounds and salts of Formula V are those wherein  $R_3$  is hydrogen and the  $R_4$  substituents present on the 3 and 5 positions of the piperazine ring are hydrogen and the  $R_4$  substituents on the 2 and 6 position of the piperazine ring are independently hydrogen or  $C_{1-4}$  alkyl. For this discussion the piperazine ring is numbered as follows:

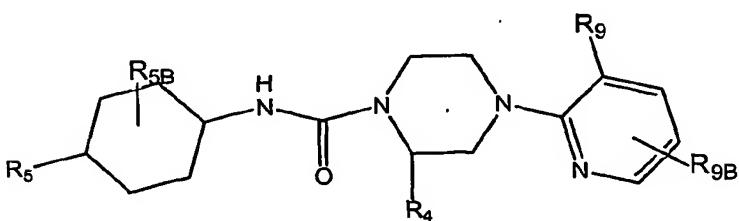


Even more preferred compounds and salts of Formula V are those wherein  $R_4$  is methyl at the 2 position of the piperazine ring and  $R_3$  and  $R_4$  are hydrogen at all other positions.

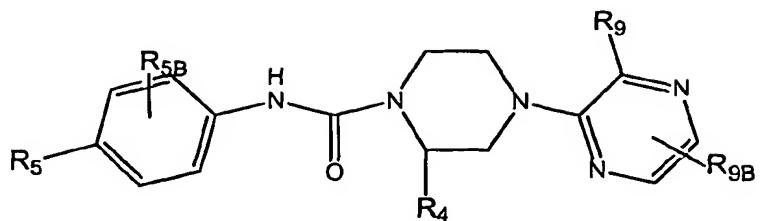
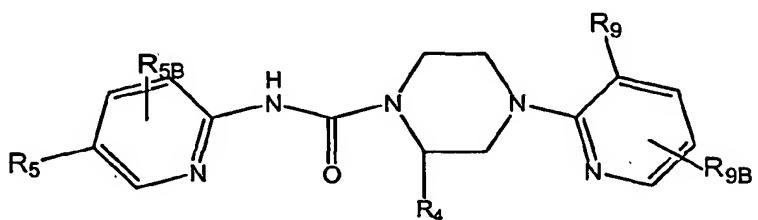
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The invention particularly includes compounds Formula A-1, Formula B-1, Formula C-1, Formula D-1, Formula E-1, and Formula F-1

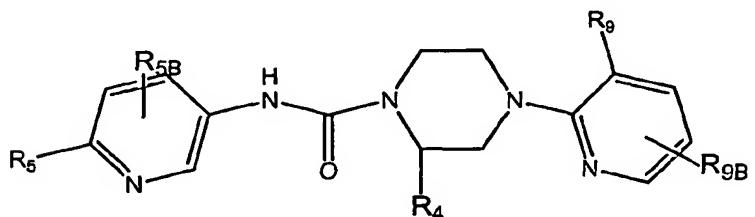
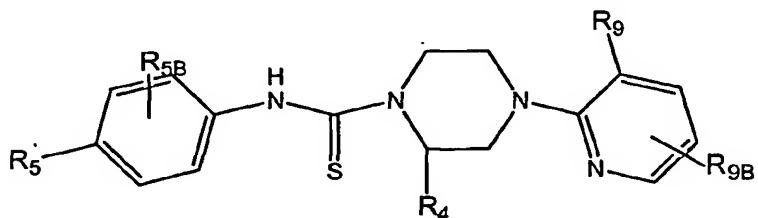
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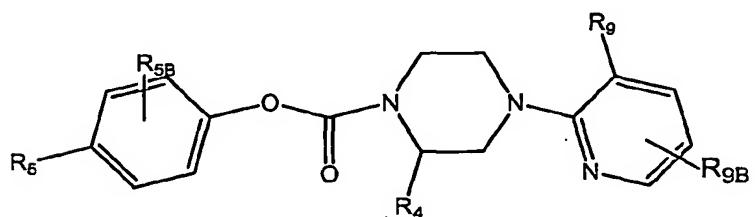
Formula A-1

Formula B-1

5

Formula C-1Formula D-1

10

Formula E-1Formula F-1

and the pharmaceutically acceptable salts of Formula A-1, Formula B-1, Formula C-1, Formula D-1, Formula E-1, and Formula F-1 wherein:

5  $R_5$  and  $R_9$  are independently selected from the group consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}$ alkyl),  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl), and  $C_{3-8}$ cycloalkyl; and

10  $R_{5B}$  and  $R_{9B}$  each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, hydroxy, amino,  $C_{1-3}$ alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}$ alkyl), and  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl).

15 Especially preferred compounds and salts of Formula A-1, Formula B-1, Formula C-1, Formula D-1, Formula E-1, and Formula F-1 are those wherein:

$R_5$  is  $C_{3-6}$  alkyl;  $C_{3-6}$  alkoxy; halo( $C_{1-3}$ )alkyl, halo( $C_{1-3}$ )alkoxy, or  $C_{3-8}$  cycloalkyl;

20  $R_9$  is chloro or trifluoromethyl; and

$R_{5B}$  and  $R_{9B}$  are hydrogen.

Representative compounds of the invention are shown in Table I below:

TABLE I

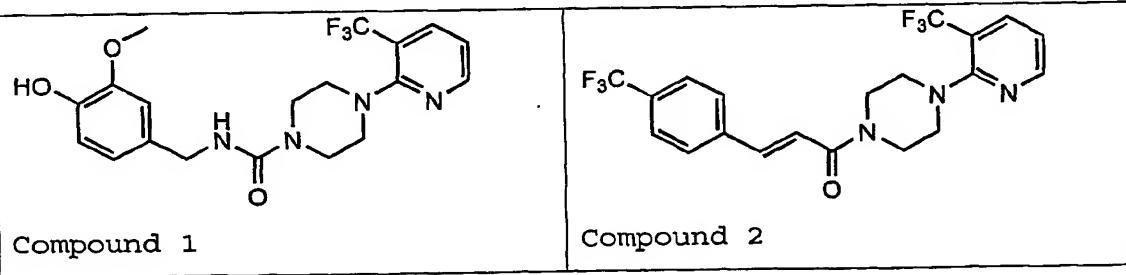
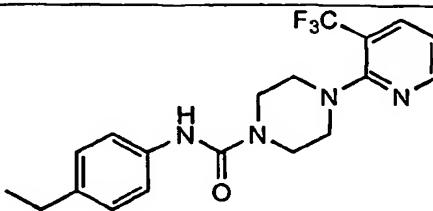
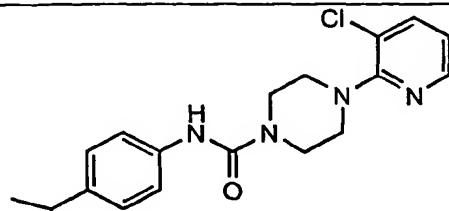
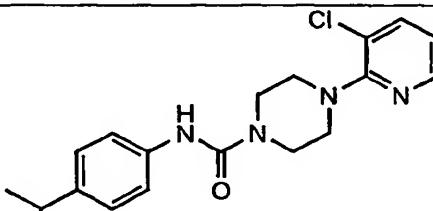
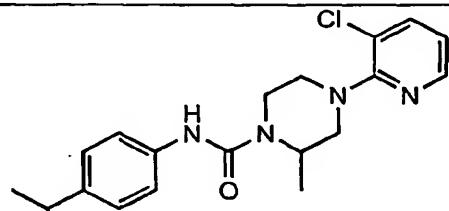


TABLE I

 Compound 3	 Compound 4
 Compound 5	 Compound 6

In one aspect invention relates to diaryl piperazines and related compounds that bind with high affinity to capsaicin receptors, including human capsaicin receptors. Compounds that bind with high affinity for the capsaicin receptor include compounds exhibit  $K_i$  values of less than 10  $\mu\text{M}$ , and preferably exhibit  $K_i$  values of less than 1  $\mu\text{M}$ , more preferably exhibit  $K_i$  values of less than 100 nM, and most preferably exhibit  $K_i$  values of less than 10 nM at the capsaicin receptors. This invention also includes diaryl piperazines that bind with high selectivity to capsaicin receptor. Compounds that exhibit high selectivity for the capsaicin receptor exhibit at least 20-fold, and preferably at least 100-fold greater affinity for the capsaicin receptor than for other cell surface receptors (e.g., NPY Y5 receptors, NPY Y1 receptors, GABA<sub>A</sub> receptors, MCH receptors, Bradykinin receptors, C5a receptors, androgen receptors, and the like).

Without wishing to be bound to any particular theory of operation, it is believed that the interaction of the compounds of Formulae I-IX and Formulae A-F with the capsaicin receptor results in the pharmaceutical utility of these compounds.

5 The invention further comprises methods of treating patients in need of such treatment with an amount of a compound of the invention sufficient to alter the symptoms of a disorder responsive to capsaicin receptor modulation. Thus, as used herein, the term treatment encompasses both disease modifying 10 treatment and symptomatic treatment.

The diseases and/ or disorders that can also be treated using compounds and compositions according to the invention (which are examples of disorders responsive to capsaicin receptor modulation) include:

15 Chronic and acute pain conditions, including toothache, postherpetic neuralgia, diabetic neuropathy, postmastectomy pain syndrome, stump pain (and phantom limb pain), reflex sympathetic dystrophy, trigeminal neuralgia, oral neuropathic pain, osteoarthritis, rheumatoid arthritis, fibromyalgia, 20 Guillain-Barre syndrome, meralgia paresthetica, "burning-mouth" syndrome, and pain due to bilateral peripheral neuropathy. Preferred pain conditions for treatment in accordance with the invention are neuropathic pain conditions, including causalgia (reflex sympathetic dystrophy - RSD, secondary to injury of a 25 peripheral nerve; this type of pain is generally considered to be non-responsive or only partially responsive to conventional opioid analgesic regimens), neuritis -including, e.g., sciatic neuritis, peripheral neuritis, polyneuritis, optic neuritis, postfebrile neuritis, migrating neuritis, segmental neuritis, 30 Gombault's neuritis, and neuronitis, and neuralgias -including those mentioned above and, e.g., cervicobrachial neuralgia,

cranial neuralgia, geniculate neuralgia, glossopharyngial neuralgia, migranous neuralgia, idiopathic neuralgia, intercostals neuralgia, mammary neuralgia, mandibular joint neuralgia, Morton's neuralgia, nasociliary neuralgia, occipital 5 neuralgia, red neuralgia, Sluder's neuralgia, splenopalatine neuralgia, supraorbital neuralgia and vidian neuralgia. Additional pain conditions that can be treated in accordance with the invention include headache - particularly those involving peripheral nerve activity including, e.g., sinus, 10 cluster (i.e., migranous neuralgia, supra) and some tension and migraine headache conditions - , labor pains, Charcot's pains, gas pains, menstrual pain, root pain, homotopic pain and heterotopic pain - including cancer associated pain, pain (and inflammation) associated with venom exposure, e.g., due to 15 snake bite, spider bite, or insect sting, and traumatic, e.g., post-surgical pain and burn pain. A preferred condition that can be treated in accordance with the invention is pain (as well as broncho-constriction and inflammation) due to exposure (e.g., via ingestion, inhalation, or eye contact) of mucous 20 membranes to capsaicin and related irritants such as tear gas, hot peppers, or pepper spray.

Itching conditions, including psoriatic pruritis, itch due to hemodialysis, aquagenic pruritus, and itching associated with vulvar vestibulitis, contact dermatitis, insect bites and skin 25 allergies.

Urinary incontinence, including detrusor hyperflexia of spinal origin and bladder hypersensitivity.

The invention also provides pharmaceutical compositions comprising compounds of the invention, including packaged 30 pharmaceutical compositions for treating disorders responsive to capsaicin receptor modulation. The packaged pharmaceutical

compositions include a container holding a therapeutically effective amount of at least one capsaicin receptor modulator as described supra and instructions (e.g., labeling) indicating the contained capsaicin receptor ligand is to be used for 5 treating a disorder responsive to capsaicin receptor modulation in the patient.

The present invention also pertains to methods of inhibiting the binding of vanilloid (capsaicin analog) compounds, such as capsaicin, olvanil and RTX, to capsaicin 10 receptors, which methods involve contacting a compound of the invention with cells expressing capsaicin receptors, wherein the compound is present at a concentration sufficient to inhibit vanilloid binding to capsaicin receptors *in vitro*. The methods of the invention include inhibiting the binding of 15 vanilloid compounds to capsaicin receptors *in vivo*, e.g., in a patient given an amount of a compound of Formulae I-IX and Formulae A-F that results in an *in vivo* concentration in a body fluid sufficient to inhibit the binding of capsaicin compounds to capsaicin receptors *in vitro*. In one embodiment, 20 such methods are useful in treating the effects of tear gas, hot pepper or pepper spray exposure. The amount of a compound that would be sufficient to inhibit the binding of a vanilloid compound to the capsaicin receptor may be readily determined via a capsaicin receptor binding assay, such as the assay 25 described in Example 10 or by an assay of capsaicin receptor antagonism e.g., as in Example 11. The capsaicin receptors used to determine *in vitro* binding may be obtained from a variety of sources, for example from preparations of mammalian dorsal root ganglion (DRG) or from cells expressing cloned rat or human 30 capsaicin receptors.

The present invention also pertains to methods for altering the signal-transducing activity, particularly the calcium ion conductance, mediated by capsaicin receptors, said method comprising exposing cells expressing such receptors to a 5 solution comprising a compound of the, wherein the compound is present in the solution at a concentration sufficient to specifically alter the calcium conductance activity in response to capsaicin or RTX in vitro in cells expressing capsaicin receptors, preferred cells for this purpose are those that 10 express high levels of capsaicin receptors (i.e., equal to or greater than the number of capsaicin receptors per cell found in rat DRG cells)... This method includes altering the signal-transducing activity of capsaicin receptors *in vivo*. Preferably such alterations are reductions of calcium flux. The amount of 15 a compound that would be sufficient to alter the signal-transducing activity of capsaicin receptors may be determined in vitro via a capsaicin receptor signal transduction assay, such as the calcium mobilization (conductance, flux) assay described in Example 11. The amount of a compound that would 20 be sufficient to alter the calcium conductance activity in response to capsaicin or RTX of capsaicin receptors may also be determined via an assay of capsaicin receptor mediated calcium conductance, such as an assay wherein the binding of capsaicin to a cell surface capsaicin receptor effects changes in the 25 fluorescence of a calcium sensitive dye or in the expression of a calcium sensitive reporter gene.

The invention further provides:

A method of reducing the calcium conductance of a capsaicin receptor, which method comprises:  
30 contacting a first solution comprising a fixed concentration of a capsaicin receptor agonist and a compound or

salt of the invention with a cell expressing the capsaicin receptor, wherein the compound or salt is present in the solution at a concentration sufficient to produce a detectable reduction of the calcium mobilization effects of the capsaicin receptor agonist when tested in an in vitro assay in which cells expressing a capsaicin receptor are contacted with a second solution comprising the fixed concentration of capsaicin receptor agonist and the compound or salt and the same method wherein: the cell expressing the capsaicin receptor is a neuronal cell that is contacted in vivo in an animal, and wherein the first solution is a body fluid of said animal; or the animal is a human patient.

A pharmaceutical composition comprising a pharmaceutically acceptable carrier and a compound or salt of the invention; and a package comprising the pharmaceutical composition in a container and further comprising indicia comprising instructions for using the composition to either alleviate pain; or to treat a patient suffering from urinary incontinence or to alleviate symptoms of exposure to capsaicin or tear gas.

A compound or salt of the invention wherein, in an in vitro assay of capsaicin receptor antagonism, the compound or salt exhibits capsaicin receptor antagonist activity, but in an in vitro assay of capsaicin receptor agonism the compound does not exhibit detectable agonist activity.

A compound or salt of the invention wherein a dose of the compound or salt sufficient to provide analgesia in an animal model for determining pain relief does not produce sedation in an animal model assay of sedation.

A method of treating a mammal suffering from at least one symptom selected from the group consisting of symptoms of exposure to capsaicin, symptoms of burns or irritation due to

exposure to heat, symptoms of burns or irritation due to exposure to light, symptoms of burns or irritation due to exposure to tear gas, and symptoms of burns or irritation due to exposure to acid, the method comprising administering to the 5 mammal a therapeutic dose of a compound that:

- a) is a high potency capsaicin receptor antagonist in an *in vitro* assay of capsaicin receptor antagonism,
- b) exhibits no detectable agonist activity in an *in vitro* assay of capsaicin receptor agonism,
- 10 c) is not a capsaicin analog, and
- d) when administered to an animal in an animal model assay of sedation, at five times the minimum dosage needed to provide analgesia in an animal model for determining pain relief, does not cause sedation,

15 wherein the therapeutic dose contains an amount of the compound that is effective to reduce severity of at least one of the at least one symptom and preferably wherein the compound is a compound of the invention.

A method of treating a mammal suffering from neuropathic 20 pain, the method comprising administering to the mammal a therapeutic dose of a compound that is a capsaicin receptor antagonist, and in certain embodiments, wherein the compound is a compound of the invention.

A method of treating a mammal suffering from peripheral- 25 nerve-mediated pain, e.g., neuropathic pain, the method comprising administering to the mammal a therapeutic dose of a compound that is a capsaicin receptor antagonist, wherein the compound:

- a) is a high potency capsaicin receptor antagonist in an *in vitro* assay of capsaicin receptor antagonism,

b) exhibits no detectable agonist activity in an *in vitro* assay of capsaicin receptor agonism,

c) is not a capsaicin analog, and

d) when administered to an animal in an animal model assay of sedation, at five times the minimum dosage needed to provide analgesia in an animal model for determining pain relief, does not cause sedation,

wherein the therapeutic dose contains an amount of the compound that is effective to reduce the peripheral-nerve-mediated pain, and preferably wherein the pain is neuropathic pain and the compound is a compound of the invention, and preferably wherein the pain is associated with a condition selected from the group consisting of postmastectomy pain syndrome, stump pain, phantom limb pain, oral neuropathic pain, Charcot's pain, toothache, postherpetic neuralgia, diabetic neuropathy, reflex sympathetic dystrophy, trigeminal neuralgia, osteoarthritis, rheumatoid arthritis, fibromyalgia, Guillain-Barre syndrome, meralgia paresthetica, burning-mouth syndrome, bilateral peripheral neuropathy, causalgia, sciatic neuritis, peripheral neuritis, polyneuritis, optic neuritis, postfebrile neuritis, migrating neuritis, segmental neuritis, Gombault's neuritis, neuronitis, cervicobrachial neuralgia, cranial neuralgia, geniculate neuralgia, glossopharyngial neuralgia, migranous neuralgia, idiopathic neuralgia, intercostals neuralgia, mammary neuralgia, mandibular joint neuralgia, Morton's neuralgia, nasociliary neuralgia, occipital neuralgia, red neuralgia, Sluder's neuralgia, splenopalatine neuralgia, supraorbital neuralgia, vidian neuralgia, sinus headache, tension headache, labor, childbirth, intestinal gas, menstruation, cancer, and trauma.

A compound of the invention, wherein the compound is not addictive.

The capsaicin receptor ligands provided by this invention and labeled derivatives thereof are also useful as standards and reagents for determining the ability of a compound to bind to the capsaicin receptor and to act as an agonist, antagonist, inverse agonist, mixed agonist/antagonist or the like.

More particularly compounds of the invention may be used for demonstrating the presence of VR1 receptors or other capsaicin receptors in cell or tissue samples. This may be done by preparing a plurality of matched cell or tissue samples, at least one of which is prepared as an experimental sample and at least one of which is prepared as a control sample. The experimental sample is prepared by contacting (under conditions that permit binding of capsaicin or RTX to capsaicin receptors within cell and tissue samples) at least one of the matched cell or tissue samples that has not previously been contacted with any compound or salt of the invention with an experimental solution comprising the detectably-labeled preparation of the selected compound or salt at a first measured molar concentration. The control sample is prepared by in the same manner as the experimental sample and is incubated in a solution that contains the same ingredients as the experimental solution but that also contains an unlabelled preparation of the same compound or salt of the invention at a molar concentration that is greater than the first measured molar concentration.

The experimental and control samples are then washed (using the same wash conditions) to remove unbound detectably-labeled compound. The amount of detectably-labeled compound remaining bound to each sample is then measured and the amount

of detectably-labeled compound in the experimental and control samples is compared. A comparison that indicates the detection of a greater amount of detectable label in the at least one washed experimental sample than is detected in any of the at least one washed control samples demonstrates the presence of 5 capsaicin receptors in that experimental sample.

The detectably-labeled compound used in this procedure may be labeled with any detectable label, such as a radioactive label, a biological tag such as biotin (which can be detected 10 by binding to detectably-labeled avidin), an enzyme (e.g., alkaline phosphatase, beta galactosidase, or a like enzyme that can be detected its activity in a colorimetric, luminescent, or like assay) or a directly or indirectly luminescent label. When tissue sections are used in this procedure and the detectably- 15 labeled compound is radiolabeled, the bound, labeled compound may be detected autoradiographically to generate an autoradiogram. When autoradiography is used, the amount of detectable label in an experimental or control sample may be measured by viewing the autoradiograms and comparing the 20 exposure density of matched regions of the autoradiograms.

Labeled derivatives the capsaicin receptor ligands provided by this invention are also useful as radiotracers for positron emission tomography (PET) imaging or for single photon emission computerized tomography (SPECT) to characterize and 25 localize capsaicin receptors *in vivo*.

Definitions .

The compounds herein described may have one or more asymmetric centers or planes. Compounds of the present invention containing an asymmetrically substituted atom may be 30 isolated in optically active or racemic forms. It is well known in the art how to prepare optically active forms, such as by

resolution of racemic forms (racemates), by asymmetric synthesis, or by synthesis from optically active starting materials. Resolution of the racemates can be accomplished, for example, by conventional methods such as crystallization in the presence of a resolving agent, or chromatography, using, for example a chiral HPLC column. Many geometric isomers of olefins, C=N double bonds, and the like can also be present in the compounds described herein, and all such stable isomers are contemplated in the present invention. *Cis* and *trans* geometric isomers of the compounds of the present invention are described and may be isolated as a mixture of isomers or as separated isomeric forms. All chiral (enantiomeric and diastereomeric), and racemic forms, as well as all geometric isomeric forms of a structure are intended, unless the specific stereochemistry or isomeric form is specifically indicated.

The term "substituted," as used herein, means that any one or more hydrogens on the designated atom is replaced with a selection from the indicated group, provided that the designated atom's normal valence is not exceeded, and that the substitution results in a stable compound. The present invention is intended to include all isotopes of atoms occurring in the present compounds. Isotopes include those atoms having the same atomic number but different mass numbers. By way of general example and without limitation, isotopes of hydrogen include tritium and deuterium. Isotopes of carbon include <sup>11</sup>C, <sup>13</sup>C, and <sup>14</sup>C.

When any variable occurs more than one time in any constituent or formula for a compound, its definition at each occurrence is independent of its definition at every other occurrence. Thus, for example, if a group is shown to be substituted with 0-2 R\*, then said group may optionally be

substituted with up to two R\* groups and R\* at each occurrence is selected independently from the definition of R\*. Also, combinations of substituents and/or variables are permissible only if such combinations result in stable compounds.

5 As indicated above, various substituents of the various formulae are "optionally substituted", including Ar<sub>1</sub>, Ar<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> of Formulae I-IX and Formulae A-F, and such substituents as recited in the sub-formulae such as Formula Ia and the like. When substituted, those substituents (e.g., C<sub>1-6</sub> alkyl, n, Ar<sub>1</sub>,  
10 Ar<sub>2</sub>, R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and R<sub>4</sub>) may be substituted by other than hydrogen at one or more available positions, typically 1 to 3 or 4 positions, by one or more groups, such as, halogen such as fluoro, chloro, bromo and iodo; cyano; hydroxyl; nitro; azido; alkanoyl such as a C<sub>1-6</sub> alkanoyl group such as acyl and the  
15 like; carboxamido; alkyl groups including those groups having 1 to about 12 carbon atoms, or 1, 2, 3, 4, 5, or 6 carbon atoms; alkenyl and alkynyl groups including groups having one or more unsaturated linkages and from 2 to about 12 carbon, or 2, 3, 4, 5 or 6 carbon atoms; alkoxy groups having those having one or  
20 more oxygen linkages and from 1 to about 12 carbon atoms, or 1, 2, 3, 4, 5 or 6 carbon atoms; aryloxy such as phenoxy; alkylthio groups including those moieties having one or more thioether linkages and from 1 to about 12 carbon atoms, or 1, 2, 3, 4, 5 or 6 carbon atoms; alkylsulfinyl groups including  
25 those moieties having one or more sulfinyl linkages and from 1 to about 12 carbon atoms, or 1, 2, 3, 4, 5, or 6 carbon atoms; alkylsulfonyl groups including those moieties having one or more sulfonyl linkages and from 1 to about 12 carbon atoms, or 1, 2, 3, 4, 5, or 6 carbon atoms; aminoalkyl groups such as  
30 groups having one or more N atoms and from 1 to about 12 carbon atoms, or 1, 2, 3, 4, 5 or 6 carbon atoms; carbocyclic aryl

having 6 or more carbons, particularly phenyl (e.g. an Ar group being a substituted or unsubstituted biphenyl moiety); arylalkyl having 1 to 3 separate or fused rings and from 6 to about 18 carbon ring atoms, with benzyl being a preferred group; arylalkoxy having 1 to 3 separate or fused rings and from 6 to about 18 carbon ring atoms, with O-benzyl being a preferred group; or a heteroaromatic or heteroalicyclic group having 1 to 3 separate or fused rings with 3 to about 8 members per ring and one or more N, O or S atoms, e.g. coumarinyl, 5 quinolinyl, pyridyl, pyrazinyl, pyrimidyl, furyl, pyrrolyl, thienyl, thiazolyl, oxazolyl, imidazolyl, indolyl, benzofuranyl, benzothiazolyl, tetrahydrofuranyl, tetrahydropyrananyl, piperidinyl, morpholino and pyrrolidinyl..

10

As used herein, "alkyl" is intended to include both 15 branched, straight-chain, and cyclic alkyl groups, having the specified number of carbon atoms that may contain one or more double or triple bonds. "Lower alkyl" denotes an alkyl group having from 1 to about 6 carbon atoms. Examples of alkyl include, but are not limited to, methyl, ethyl, n-propyl, 20 i-propyl, n-butyl, s-butyl, t-butyl, n-pentyl, and s-pentyl. Preferred alkyl groups are C<sub>1</sub>-C<sub>6</sub> alkyl groups. Especially preferred alkyl groups are methyl, ethyl, propyl, butyl, 3-pentyl.

As used herein, "alkoxy", "C<sub>1</sub>-C<sub>6</sub> alkoxy", or "lower alkoxy" 25 in the present invention is meant an alkyl group attached through an oxygen bridge such as, for example, methoxy, ethoxy, propoxy, isopropoxy, n-butoxy, sec-butoxy, tert-butoxy, pentoxy, 2-pentyl, isopentoxy, neopentoxy, hexoxy, 2-hexaoxy, 3-hexaoxy, and 3-methylpentoxy. "Lower alkoxy" denotes an alkyl 30 group having from 1 to about 6 carbon atoms.

"Haloalkyl" is intended to include both branched and straight-chain saturated aliphatic hydrocarbon groups having the specified number of carbon atoms, substituted with 1 or more halogen (for example -C<sub>v</sub>F<sub>w</sub> where v = 1 to 3 and w = 1 to 5 (2v+1)). Examples of haloalkyl include, but are not limited to, trifluoromethyl, trichloromethyl, pentafluoroethyl, heptafluoropropyl, and pentachloroethyl.

As used herein, "carbocycle" or "carbocyclic ring" is intended to mean any stable 3- to 7-membered monocyclic or 10 bicyclic or 7-to 13-membered bicyclic or tricyclic moiety, any of which may be saturated, partially unsaturated, or aromatic. Examples of such carbocycles include, but are not limited to, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, adamantyl, cyclooctyl, [3.3.0]bicyclooctane, 15 [4.3.0]bicyclononane, [4.4.0]bicyclodecane, [2.2.2]bicyclooctane, fluorenyl, phenyl, naphthyl, indanyl, adamantyl, and tetrahydronaphthyl.

As used herein, the term "carbocyclic aryl" indicates aromatic groups containing only carbon. Such aromatic groups 20 may be further substituted.

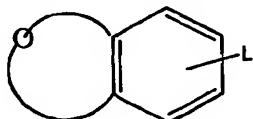
As used herein, the term "heterocyclic ring" is intended to mean a stable 5-to 7-membered monocyclic or bicyclic or 7-to 10-membered bicyclic heterocyclic ring which is saturated, partially unsaturated, or unsaturated (aromatic), and which 25 consists of carbon atoms and from 1 to 4 heteroatoms independently selected from the group consisting of N, O and S and including any bicyclic group in which any of the above-defined heterocyclic rings is fused to a benzene ring. The nitrogen and sulfur heteroatoms may optionally be oxidized. 30 The heterocyclic ring may be attached to its pendant group at any heteroatom or carbon atom that results in a stable

structure. The heterocyclic rings described herein may be substituted on carbon or on a nitrogen atom if the resulting compound is stable. A nitrogen atom in the heterocycle may optionally be quaternized. It is preferred that when the total 5 number of S and O atoms in the heterocycle exceeds 1, then these heteroatoms are not adjacent to one another. It is preferred that the total number of S and O atoms in the heterocycle is not more than 1. As used herein, the term "heteroaryl" is intended to mean a stable 5-to 7-membered 10 monocyclic or bicyclic or 7-to 10-membered bicyclic heterocyclic aromatic ring which consists of carbon atoms and from 1 to 4 heteroatoms independently selected from the group consisting of N, O and S. It is preferred that the total number of S and O atoms in the aromatic heterocycle. is not more than 15 1. The term "heterocycloalkyl" is intended to mean a stable 5-to 7-membered monocyclic or bicyclic or 7-to 10-membered bicyclic heterocyclic saturated ring which consists of carbon atoms and from 1 to 4 heteroatoms independently selected from the group consisting of N, O and S. Examples of heterocycles 20 include, but are not limited to, acridinyl, azocinyl, benzimidazolyl, benzofuranyl, benzothiofuranyl, benzothiophenyl, benzoxazolyl, benzthiazolyl, benztriazolyl, benztetrazolyl, benzisoxazolyl, benzisothiazolyl, benzimidazolinyl, carbazolyl, NH-carbazolyl, carbolinyl, 25 chromanyl, chromenyl, cinnolinyl, decahydroquinolinyl, 2H,6H-1,5,2-dithiazinyl, dihydrofuro[2,3-*b*]tetrahydrofuran, furanyl, furazanyl, imidazolidinyl, imidazolinyl, imidazolyl, 1H-indazolyl, indolenyl, indolinyl, indolizinyl, indolyl, 3H-indolyl, isobenzofuranyl, isochromanyl, isoindazolyl, 30 isoindolinyl, isoindolyl, isoquinolinyl, isothiazolyl, isoxazolyl, morpholinyl, naphthyridinyl,

octahydroisoquinolinyl, oxadiazolyl, 1,2,3-oxadiazolyl,  
 1,2,4-oxadiazolyl; 1,2,5-oxadiazolyl, 1,3,4-oxadiazolyl,  
 oxazolidinyl, oxazolyl, oxazolidinyl, pyrimidinyl,  
 phenanthridinyl, phenanthrolinyl, phenazinyl, phenothiazinyl,  
 5 phenoxathiinyl, phenoxazinyl, phthalazinyl, piperazinyl,  
 piperidinyl, pteridinyl, purinyl, pyranyl, pyrazinyl,  
 pyrazolidinyl, pyrazolinyl, pyrazolyl, pyridazinyl,  
 pyridooxazole, pyridoimidazole, pyridothiazole, pyridinyl,  
 pyridyl, pyrimidinyl, pyrrolidinyl, pyrrolinyl, 2H-pyrrolyl,  
 10 pyrrolyl, quinazolinyl, quinolinyl, 4H-quinolizinyl,  
 quinoxalinyl, quinuclidinyl, tetrahydrofuranyl,  
 tetrahydroisoquinolinyl, tetrahydroquinolinyl,  
 6H-1,2,5-thiadiazinyl, 1,2,3-thiadiazolyl, 1,2,4-thiadiazolyl,  
 1,2,5-thiadiazolyl, 1,3,4-thiadiazolyl, thianthrenyl, thiazolyl,  
 15 thienyl, thienothiazolyl, thienooxazolyl, thienoimidazolyl,  
 thiophenyl, triazinyl, 1,2,3-triazolyl, 1,2,4-triazolyl,  
 1,2,5-triazolyl, 1,3,4-triazolyl, and xanthenyl.

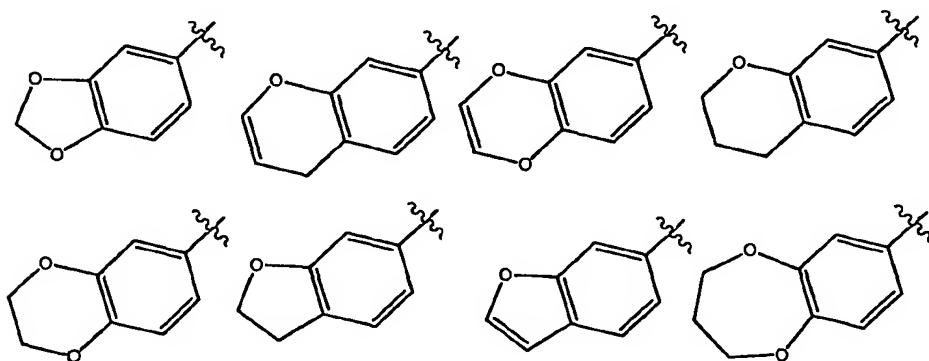
Preferred heterocycles include, but are not limited to,  
 20 pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl,  
 isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl,  
 tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl,  
 indolyl, isoindolyl, benzofuranyl, isobenzofuranyl,  
 benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl,  
 isoquinolinyl, cinnolinyl, quinazolinyl, or quinoxalinyl.  
 25 Also included are fused ring and spiro compounds containing,  
 for example, the above heterocycles.

The term "bicyclic oxygen-containing group" is meant to encompass a particular type of heteroaryl group of the formula:



where L indicates the point of attachment of the group to the structure of Formulae I-IX and Formulae A-F. The heterocyclic oxygen-containing ring has a total of from 5 to 7 members, and is saturated or unsaturated. Either ring of the bicyclic 5 oxygen-containing group may be further substituted.

Examples of bicyclic oxygen-containing groups include any or all of the following structures:



#### Pharmaceutical preparations

10 Those skilled in the art will recognize various synthetic methodologies that may be employed to prepare non-toxic pharmaceutically acceptable prodrugs of the compounds encompassed by Formulae I-IX and Formulae A-F, which prodrugs are encompassed by the present invention. "Prodrugs" are intended to include any compounds that become compounds of Formulae I-IX and Formulae A-F when administered to a mammalian subject, e.g., upon metabolic processing of the prodrug. Examples of prodrugs include, but are not limited to, acetate, formate and benzoate and like derivatives of functional groups 15 (such as alcohol or amine groups) in the compounds of Formulae I-IX and Formulae A-F. Those skilled in the art will recognize a wide variety of non-toxic pharmaceutically acceptable solvents that may be used to prepare solvates of the compounds of the invention, such as water, ethanol, mineral oil, 20 vegetable oil, and dimethylsulfoxide.

25

The compounds of general Formulae I-IX and general Formulae A-F may be administered orally, topically, parenterally, e.g., by inhalation or spray or rectally in dosage unit formulations containing conventional non-toxic pharmaceutical acceptable carriers, adjuvants and vehicles. Oral administration in the form of a pill, capsule, elixir, syrup, lozenge, troche, or the like is particularly preferred. The term parenteral as used herein includes subcutaneous injections, intradermal, intravascular (e.g., intravenous), intramuscular, spinal, intrathecal injection or like injection or infusion techniques. In addition, there is provided a pharmaceutical formulation comprising a compound of general Formulae I-IX and general Formulae A-F and a pharmaceutically acceptable carrier. One or more compounds of general Formulae I-IX and general Formulae A-F may be present in association with one or more non-toxic pharmaceutically acceptable carriers and/or diluents and/or adjuvants and if desired other active ingredients. The pharmaceutical compositions containing compounds of general Formulae I-IX and general Formulae A-F may be in a form suitable for oral use, for example, as tablets, troches, lozenges, aqueous or oily suspensions, dispersible powders or granules, emulsion, hard or soft capsules, or syrups or elixirs.

Compositions intended for oral use may be prepared according to any method known to the art for the manufacture of pharmaceutical compositions and such compositions may contain one or more agents selected from the group consisting of sweetening agents, flavoring agents, coloring agents and preserving agents in order to provide pharmaceutically elegant and palatable preparations. Tablets contain the active ingredient in admixture with non-toxic pharmaceutically

acceptable excipients that are suitable for the manufacture of tablets. These excipients may be for example, inert diluents, such as calcium carbonate, sodium carbonate, lactose, calcium phosphate or sodium phosphate; granulating and disintegrating agents, for example, corn starch, or alginic acid; binding agents, for example starch, gelatin or acacia, and lubricating agents, for example magnesium stearate, stearic acid or talc. The tablets may be uncoated or they may be coated by known techniques to delay disintegration and absorption in the gastrointestinal tract and thereby provide a sustained action over a longer period. For example, a time delay material such as glyceryl monostearate or glyceryl distearate may be employed. Formulations for oral use may also be presented as hard gelatin capsules wherein the active ingredient is mixed with an inert solid diluent, for example, calcium carbonate, calcium phosphate or kaolin, or as soft gelatin capsules wherein the active ingredient is mixed with water or an oil medium, for example peanut oil, liquid paraffin or olive oil.

Aqueous suspensions contain the active materials in admixture with excipients suitable for the manufacture of aqueous suspensions. Such excipients are suspending agents, for example sodium carboxymethylcellulose, methylcellulose, hydropropylmethylcellulose, sodium alginate, polyvinylpyrrolidone, gum tragacanth and gum acacia; dispersing or wetting agents may be a naturally-occurring phosphatide, for example, lecithin, or condensation products of an alkylene oxide with fatty acids, for example polyoxyethylene stearate, or condensation products of ethylene oxide with long chain aliphatic alcohols, for example heptadecaethyleneoxycetanol, or condensation products of ethylene oxide with partial esters derived from fatty acids and a hexitol such as polyoxyethylene

sorbitol monooleate, or condensation products of ethylene oxide with partial esters derived from fatty acids and hexitol anhydrides, for example polyethylene sorbitan monooleate. The aqueous suspensions may also contain one or more preservatives, 5 for example ethyl, or n-propyl p-hydroxybenzoate, one or more coloring agents, one or more flavoring agents, and one or more sweetening agents, such as sucrose or saccharin.

Oily suspensions may be formulated by suspending the active ingredients in a vegetable oil, for example arachis oil, 10 olive oil, sesame oil or coconut oil, or in a mineral oil such as liquid paraffin. The oily suspensions may contain a thickening agent, for example beeswax, hard paraffin or cetyl alcohol. Sweetening agents such as those set forth above, and flavoring agents may be added to provide palatable oral 15 preparations. These compositions may be preserved by the addition of an anti-oxidant such as ascorbic acid.

Dispersible powders and granules suitable for preparation of an aqueous suspension by the addition of water provide the active ingredient in admixture with a dispersing or wetting 20 agent, suspending agent and one or more preservatives.

Suitable dispersing or wetting agents and suspending agents are exemplified by those already mentioned above. Additional excipients, for example sweetening, flavoring and coloring agents, may also be present.

25 Pharmaceutical compositions of the invention may also be in the form of oil-in-water emulsions. The oily phase may be a vegetable oil, for example olive oil or arachis oil, or a mineral oil, for example liquid paraffin or mixtures of these. Suitable emulsifying agents may be naturally-occurring gums, 30 for example gum acacia or gum tragacanth, naturally-occurring phosphatides, for example soy bean, lecithin, and esters or

partial esters derived from fatty acids and hexitol, anhydrides, for example sorbitan monoleate, and condensation products of the said partial esters with ethylene oxide, for example polyoxyethylene sorbitan monoleate. The emulsions may 5 also contain sweetening and flavoring agents.

Syrups and elixirs may be formulated with sweetening agents, for example glycerol, propylene glycol, sorbitol or sucrose. Such formulations may also contain a demulcent, a preservative and flavoring and coloring agents. The 10 pharmaceutical compositions may be in the form of a sterile injectable aqueous or oleaginous suspension. This suspension may be formulated according to the known art using those suitable dispersing or wetting agents and suspending agents which have been mentioned above. The sterile injectable 15 preparation may also be sterile injectable solution or suspension in a non-toxic parentally acceptable diluent or solvent, for example as a solution in 1,3-butanediol. Among the acceptable vehicles and solvents that may be employed are water, Ringer's solution and isotonic sodium chloride solution. 20 In addition, sterile, fixed oils are conventionally employed as a solvent or suspending medium. For this purpose any bland fixed oil may be employed including synthetic mono- or diglycerides. In addition, fatty acids such as oleic acid find use in the preparation of injectables.

25 The compounds of general Formulae I-IX and general Formulae A-F may also be administered in the form of suppositories, e.g., for rectal or vaginal administration of the drug. These compositions can be prepared by mixing the drug with a suitable non-irritating excipient that is solid at 30 ordinary temperatures but liquid at the rectal temperature and

will therefore melt in the rectum to release the drug. Such materials are cocoa butter and polyethylene glycols.

Compounds of general Formulae I-IX and general Formulae A-F may be administered parenterally in a sterile medium. The 5 drug, depending on the vehicle and concentration used, can either be suspended or dissolved in the vehicle.

Advantageously, adjuvants such as local anesthetics, preservatives and buffering agents can be dissolved in the vehicle where desirable.

10 Typical subjects to which compounds of the invention may be administered will be mammals, particularly primates, especially humans. For veterinary applications, a wide variety of subjects will be suitable, e.g. livestock such as cattle, sheep, goats, cows, swine and the like; poultry such as 15 chickens, ducks, geese, turkeys, and the like; and other domesticated animals particularly pets (companion animals) such as dogs and cats. For diagnostic or research applications, a wide variety of mammals will be suitable subjects including rodents (e.g. mice, rats, hamsters), rabbits, primates, and 20 swine such as inbred pigs and the like.

For administration to non-human animals, the composition may also be added to the animal feed or drinking water. It will be convenient to formulate these animal feed and drinking water compositions so that the animal takes in an appropriate 25 quantity of the composition along with its diet. It will also be convenient to present the composition as a premix for addition to the feed or drinking water.

For systemic (as opposed to local or topical) administration, dosage levels of the order of from about 30 0.01 mg to about 140 mg per kilogram of body weight per day are useful in the treatment of pain, urinary incontinence, or other

of the above-indicated conditions (about 0.05 mg to about 7 g per human patient per day). Preferred systemic doses for preferred high potency compounds of Formulae I-IX and Formulae A-F range from about 0.01 mg to about 50 mg per kilogram of 5 body weight per subject per day, with oral doses generally being about 5-20 fold higher than intravenous doses. The most highly preferred compounds of the invention are orally active (e.g., provide a reduction of pain or a reduction of frequency of urinary incontinence) at doses ranging from 0.05 to 40 mg 10 per kilogram of body weight per subject per day.

The amount of active ingredient that may be combined with the carrier materials to produce a single dosage form will vary depending upon the host treated and the particular mode of administration. Dosage unit forms will generally contain 15 between from about 1 mg to about 500 mg of an active ingredient.

Frequency of dosage may also vary depending on the compound used and the particular disease treated. However, for treatment of most disorders, a dosage regimen (frequency of 20 administration) of 4 times daily or less is preferred. For the treatment of chronic pain or urinary incontinence a dosage regimen of 2 times daily is more preferred and a frequency of administration of once a day is particularly preferred. For the treatment of acute pain a single dose that rapidly reaches 25 effective concentrations is desirable.

It will be understood, however, that the specific dose level for any particular patient will depend upon a variety of factors including the activity of the specific compound employed, the age, body weight, general health, sex, diet, time 30 of administration, route of administration, and rate of

excretion, drug combination and the nature and severity of the particular disease or condition undergoing treatment.

Preferred compounds of the invention will have certain desirable pharmacological properties. For systemic administration such properties include, but are not limited to high oral bioavailability, such that the preferred oral dosages and dosage forms discussed above can provide therapeutically effective levels of the compound *in vivo*, low serum protein binding and low first pass hepatic metabolism. For all types of administration low toxicity, and desirable *in vitro* and *in vivo* half-lives are desired. While penetration of the blood brain barrier for compounds used to treat CNS disorders is necessary, low brain levels of compounds used to treat peripheral disorders (such as urinary incontinence, or chronic or acute pain that does not originate from the CNS) are often preferred.

Laboratory assays may be used to predict these desirable pharmacological properties. The discussion that follows is supplemented by the detailed protocols of Example 16, *infra*. Assays used to predict bioavailability include transport across human intestinal cell monolayers, including Caco-2 cell monolayers. Toxicity to cultured hepatocytes may be used to predict compound toxicity, with non-toxic compounds being preferred. Penetration of the blood brain barrier of a compound in humans may be predicted from the brain levels of the compound in laboratory animals given the compound, e.g., intravenously.

Percentage of serum protein binding may be predicted from albumin binding assays. Examples of such assays are described in a review by Oravcová, et al. (Journal of Chromatography B (1996) volume 677, pages 1-27). Preferred compounds exhibit reversible serum protein binding. Preferably this binding is

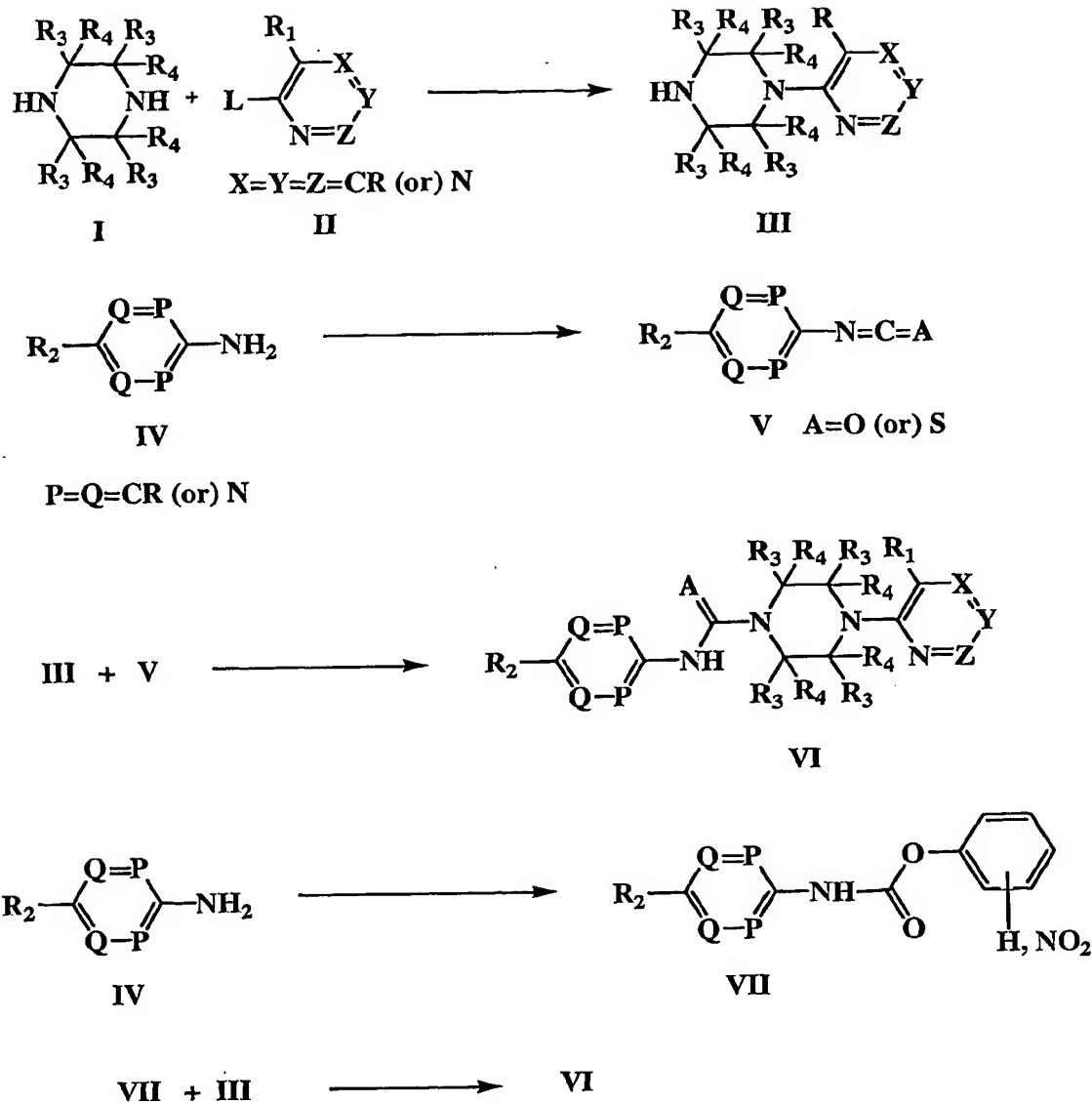
less than 99%, more preferably less than 95%, even more preferably less than 90%, and most preferably less than 80%.

Frequency of administration is generally inversely proportional to the *in vivo* half-life of a compound. *In vivo* half-lives of compounds may be predicted from the results of assays, e.g., *in vitro* assays of microsomal half-life as described by Kuhnz and Gieschen (*Drug Metabolism and Disposition*, 1998, volume 26, pages 1120-1127). Preferred half-lives are those allowing for a preferred frequency of administration.

#### Preparation of compounds

The compounds of the present invention can be prepared in a number of ways well known to those skilled in the art of organic synthesis. By way of example, compounds of the present invention can be synthesized using the methods described below, together with synthetic methods known in the art of synthetic organic chemistry, or variations thereon as appreciated by those skilled in the art. Preferred methods include but are not limited to those methods described below. Compounds of the present invention i.e. urea or thiourea derivatives (VI) can be synthesized by following the steps outlined in Scheme 1.

Scheme 1

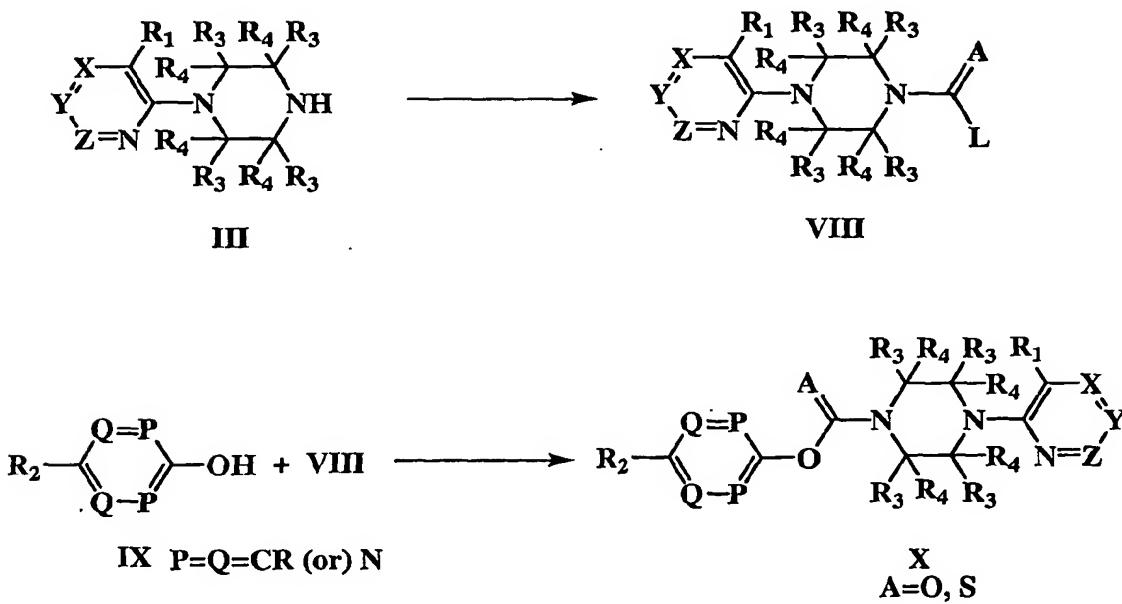


Intermediate III can be obtained by treating I with II in the presence of a base (eg: K<sub>2</sub>CO<sub>3</sub>, Cs<sub>2</sub>CO<sub>3</sub>, NR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>, NaOR, KOR) in an inert solvent such as N,N-dialkylformamide, N,N-dialkylacetamide, dialkylethers, cyclic ethers, DMSO, N-methyl-2-pyrrolidinone at temperatures ranging from -78 °C to 200 °C. Isocyanates or isothiocyanates of V can be obtained by treating

compound of IV with phosgene, thiophosgene, carbonyldiimidazole in an inert solvent such as benzene, toluene at temperatures ranging from -78 °C to 200 °C. The compound of present invention VI can be obtained by treating intermediates III with V in an 5 organic solvent at temperatures -78 °C to 200 °C. Alternatively compound of VI can be prepared by treatment of intermediate VII with III in the presence of base such as triethylamine in an inert solvent such as chloroform at temperatures ranging from -78 °C to 200 °C.

10 Carbamates or thiocarbamates (X) of the present invention can be synthesized by following the steps outlined in Scheme 2.

Scheme 2



15 Intermediate III can be converted to VIII ( $A=O$ ,  $S$ ,  $L=$ halogen, imidazole) upon treatment with phosgene, thiophosgene or carbonyldiimidazoles. Compound of product X can be obtained by treatment with phenols (IX) with compound VIII

in the presence of a base in an inert solvent at temperatures ranging from -78 °C to 200 °C.

Those having skill in the art will recognize that the starting materials may be varied and additional steps employed 5 to produce compounds encompassed by the present inventions, as demonstrated by the following examples. Unless otherwise specified all reagents and solvent are of standard commercial grade and are used without further purification.

10 The disclosures in this application of all articles and references, including patents, are incorporated herein by reference.

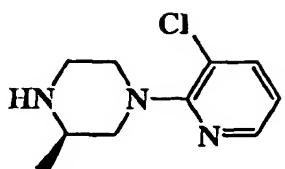
15 The invention is illustrated further by the following examples, which are not to be construed as limiting the invention in scope or spirit to the specific procedures described in them. Those having skill in the art will recognize that the starting materials may be varied and additional steps employed to produce compounds encompassed by the present inventions, as demonstrated by the following examples. In some cases, protection of certain reactive functionalities may be 20 necessary to achieve some of the above transformations. In general, such need for protecting groups, as well as the conditions necessary to attach and remove such groups, will be apparent to those skilled in the art of organic synthesis.

EXAMPLES

25 EXAMPLE 1

(R)-4-(3-Chloro-pyridin-2-yl)-2-methyl-piperazine-1-carboxylic acid (4-sec-butyl-phenyl)-amide

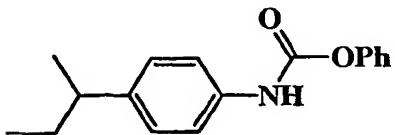
30 Part A: Synthesis of (R)-1-(3-Chloro-pyridin-2-yl)-3-methyl-piperazine:



Dissolve 2,3-dichloropyridine (8.5 g, 0.057 moles) and (R)-(-)-2-methylpiperazine (5.75 g, 0.057 moles) in N,N-dimethylacetamide (125.0 mL) under nitrogen atmosphere. Add anhydrous powdered K<sub>2</sub>CO<sub>3</sub> (23.75 g, 0.172 moles) to this mixture and stir at 135-140 °C for 48 h. New spot noticed in TLC (5 % MeOH / CHCl<sub>3</sub> / 1 % NET<sub>3</sub>) along with absence of starting materials. Cool the reaction mixture to room temperature, dilute with water (400 mL), extract with EtOAc (3 x 200 mL) and wash the combined organic extract with brine (2 x 150 mL). Dry over MgSO<sub>4</sub>, concentrate under vacuum to afford crude product (20.0 g) as orange yellow liquid. Distil the crude under high vacuum to afford pyridylpiperazine derivative as yellow viscous oil (10 g, bp 112-115 °C / 0.1 torr). NMR (CDCl<sub>3</sub>): δ 1.1-1.12 (d, 3H, J=1.6 Hz), 2.50-2.53 (t, 1H), 2.83-2.87 (m, 1H), 3.06-3.08 (m, 3H), 3.67-3.75 (m, 2H), 6.80-6.82 (dd, 1H), 7.56-7.58 (dd, 1H), 8.17-8.18 (dd, 1H).

20

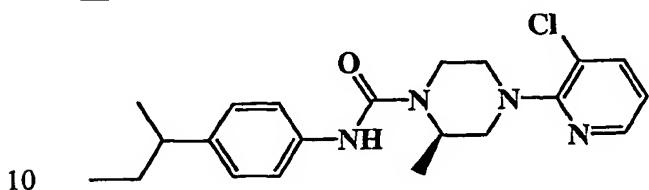
Part B: Synthesis of (4-sec-Butyl-phenyl)-carbamic acid phenyl ester:



25 Dissolve 4-isobutyylaniline (4.5 g, 0.03 moles) in pyridine (30 mL) under nitrogen at room temperature. Add drop wise phenyl

chloroformate (3.75 mL, 0.03 moles) to the reaction mixture at room temperature. Stir the mixture for 3 days and new spot noticed in TLC (30 % EtOAc / hexane). Evaporate the reaction mixture under vacuo, partition between EtOAc and water (200 mL), wash several times with brine, dry ( $MgSO_4$ ) and concentrate in vacuo. Purify the crude by flash column chromatography on a silica gel using (10 % EtOAc / hexanes) to afford white solid.

Part C: Title Compound:



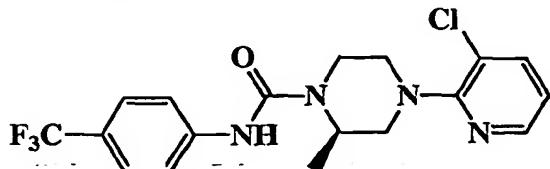
Dissolve Part A material of Example 1 (212 mg, 1.0 mmole) with Part B material of Example 1 (269 mg, 1.0 mmole) in  $CHCl_3$  (10 mL) under nitrogen at room temperature. Add triethylamine (202 mg, 2.0 mmol) to the mixture and reflux for 4 hours. Cool the reaction mixture to room temperature, wash with 2N aq. NaOH, water and dry ( $MgSO_4$ ). Evaporate the dried extract in vacuo and purify by flash column chromatography on a silica gel using  $CHCl_3$  to afford white solid.

20

NMR ( $CDCl_3$ ):  $\delta$  0.78-0.83 (t, 3H), 1.19-1.22 (d, 3H,  $J=2.2$  Hz), 1.43-1.45 (d, 3H,  $J=2.3$  Hz), 1.51-1.61 (m, 2H), 2.51-2.58 (m, 1H), 2.92-3.05 (m, 2H), 3.41-3.50 (m, 1H), 3.73-3.94 (m, 3H), 4.35 (m, 1H), 6.33 (bs, 1H), 6.86-6.90 (dd, 1H), 7.09-7.13 (m, 2H), 7.26-7.30 (m, 2H), 7.60-7.63 (dd, 1H), 8.18-8.20 (dd, 1H).

Example 2

(R) - (-) - 4 - (3-Chloro-pyridin-2-yl) - 2-methyl-piperazine-1-carboxylic acid (4-trifluoromethyl-phenyl) - amide



5 Dissolve Part A material of example 1 (0.2756 g, 1.3 mmoles) in toluene (1.5 mL) under nitrogen at room temperature. Add drop wise 4-trifluoromethylphenyl isocyanate (0.2431 g, 1.3 mmoles) dissolved in toluene (50 mL) to the mixture over a period of 30 mins and stir at room temperature for 3 hours. Evaporate the solvent from reaction mixture under vacuum to afford colorless oil. Crystallize the oil from 1:1 Et<sub>2</sub>O / hexane (2.0 mL) to afford white solid.

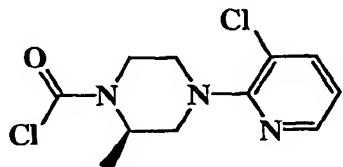
15 NMR (CDCl<sub>3</sub>): δ 1.45-1.47 (d, 3H, J=1.7 Hz), 2.97-3.01 (t, 1H), 3.06-3.10 (m, 1H), 3.47-3.50 (m, 1H), 3.75-3.85 (m, 2H), 3.92-3.95 (m, 1H), 4.37-4.38 (m, 1H), 6.59 (bs, 1H), 6.88-6.91 (dd, 1H), 7.52-7.56 (m, 4H), 7.61-7.63 (dd, 1H), 8.19-8.21 (dd, 1H).

20 Mass spectrum (ESI): 399.3 (M+H).  
Analysis calcd. for C<sub>18</sub>H<sub>18</sub>ClF<sub>3</sub>N<sub>4</sub>O: C, 54.21; H, 4.55; Cl, 8.89; F, 14.29; N, 14.05. Found: C, 54.47; H, 4.36; Cl, 8.50; F, 14.99; N, 13.94

25 Example 3

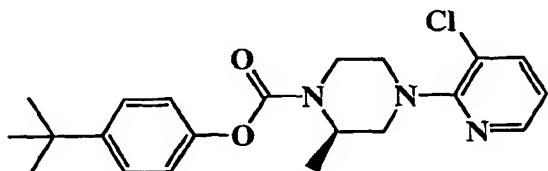
(R) - 3-Chloro-pyridin-2-yl) - 2-methyl-piperazine-1-carboxylic acid 4-tert-butyl-phenyl ester

Part A: Synthesis of (R)-4-(3-Chloro-pyridin-2-yl)-2-methyl-piperazine-1-carbonyl chloride:



5 Dissolve Part A material of Example 1 (1.06 g, 5.0 mmole)) in  $\text{CH}_2\text{Cl}_2$  (50 mL) and saturated  $\text{NaHCO}_3$  (50 mL) under nitrogen at room temperature. Add drop wise 20 %  $\text{COCl}_2$  in toluene (5.0 mL) at room temperature and stir overnight. Separate the organic layer, extract the aq. layer with  $\text{CH}_2\text{Cl}_2$  (2 x 15 mL) and dry (10  $\text{MgSO}_4$ ). Evaporate the organic layer under vacuo to afford yellow oil.

Part B: Title Compound:



15 Dissolve Part A material of Example 3 (136 g, 0.5 mmole)) in pyridine (2.0 mL) under nitrogen at room temperature. Add 4-tert. butylphenol to the reaction mixture at room temperature and stir overnight. Evaporate the reaction mixture under vacuo, 20 partition between water /  $\text{CH}_2\text{Cl}_2$  (20 mL) and dry (10  $\text{MgSO}_4$ ). Evaporate the organic layer under vacuo and purify by flash column chromatography on silica gel using 15 % EtOAc / hexane to afford colorless oil.

25 NMR ( $\text{CDCl}_3$ ):  $\delta$  1.28-1.31 (3 s, 9H), 1.35-1.48 (m, 3H), 2.96-3.11 (m, 2H), 3.49 (m, 1H), 3.72-3.80 (m, 2H), 4.13-4.24 (m,

1H), 4.55-4.60 (m, 1H), 6.74-6.92 (m, 2H), 7.04-7.07 (m, 1H), 7.23-7.26 (m, 1H), 7.36-7.38 (m, 1H), 7.61-7.64 (m, 1H), 8.19-8.22 (m, 1H).

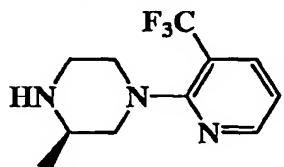
5 Mass spectrum (ESI): 388.2 (M+H).

Example 4

2-Methyl-4-(3-trifluoromethyl-pyridin-2-yl)-piperazine-1-carboxylic acid [4-(2,2,2-trifluoro-1-methyl-ethyl)-phenyl]-amide

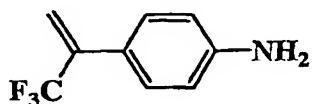
10 amide

Part A : Synthesis of 3-Methyl-1-(3-trifluoromethyl-pyridin-2-yl)-piperazine



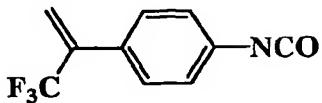
15

Dissolve 2-chloro-3-trifluoromethylpyridine (5.4 g, 0.03 moles) and (R)-(-)-2-methylpiperazine (3.0 g, 0.03 moles) in N,N-dimethylacetamide (100.0 mL) under nitrogen atmosphere. Add anhydrous powdered K<sub>2</sub>CO<sub>3</sub> (12.4 g, 0.09 moles) to this mixture 20 and stir at 135-140 °C for 24 h. New spot noticed in TLC (5 % MeOH / CHCl<sub>3</sub> / 1 % NET<sub>3</sub>) along with absence of starting materials. Cool the reaction mixture to room temperature, dilute with water (300 mL), extract with EtOAc (3 x 200 mL) and wash the combined organic extract with brine (2 x 150 mL). Dry 25 over MgSO<sub>4</sub>, concentrate under vacuum to afford crude product as orange yellow liquid. Purify by flash column chromatography using 1 % MeOH / CHCl<sub>3</sub> to afford yellow viscous oil.

Part B: Synthesis of 4-(1-Trifluoromethyl-vinyl)-phenylamine

Dissolve 4-(4,4,5,5-tetramethyl-1,2,3-dioxaborolan-2-yl)aniline (2.19 g, 0.01 moles) and 2-Bromo-3,3,3-trifluoro-propene (2.61 g, 0.015 moles) in 1:1 THF/1,2-dimethoxyethane (30 mL) and cooled in an ice bath under nitrogen atmosphere. Add  $\text{PdCl}_2[(\text{PPh}_3)_2]$  (210 mg, 3 mol %) and  $\text{AsPh}_3$  (459 mg, 15 mol %) to the reaction mixture followed by dropwise addition of 2.0 N Aq. 10  $\text{NaOH}$  (20 mL). Stirred the resultant mixture at room temp for 1 h followed by 70 °C for 15 h. Add additional 1.5 eq. of 2-Bromo-3,3,3-trifluoro-propene (2.61 g) to the reaction mixture and continued at 70 °C for 6 h. Evaporate the reaction mixture under vacuo, dissolve the residue in water/EtOAc (100 mL each), 15 separate the organic layer, extract the aq. layer with EtOAc (2 x 100 mL), combine the organic layers and dry with  $\text{MgSO}_4$ . Filter the dried extract, evaporate under vacuo and purify the crude by flash column chromatography on a silica gel using  $\text{CHCl}_3$  to afford yellow oil.

20

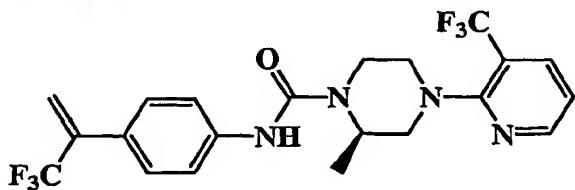
Part C: Synthesis of 1-Isocyanato-4-(1-trifluoromethyl-vinyl)-benzene

25

Cool 20 % phosgene in toluene (5.0 mL) to -40 °C under N2 atmosphere. Dissolve Part B material of Example 4 (0.47 g, 2.5 mmoles) in toluene and add dropwise to the cooled stirred

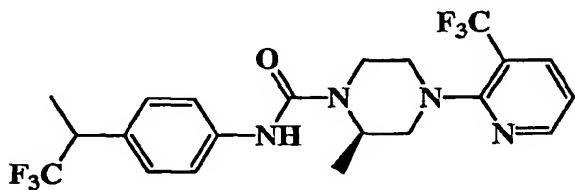
solution. Stir at -40 °C for 30 mins followed by room temperature for 1 h and then at reflux for 1 h. Concentrate in vacuo to afford orange yellow liquid.

5 Part D: Synthesis of 2-Methyl-4-(3-trifluoromethyl-pyridin-2-yl)-piperazine-1-carboxylic acid [4-(1-trifluoromethyl-vinyl)-phenyl]-amide



10 Dissolve Part A material of example 4 (0.123 g, 0.5 mmoles) in toluene (1.0 mL) under nitrogen at room temperature. Add drop wise Part C material of Example 4 (0.106 g, 0.5 mmoles) dissolved in toluene (1.0 mL) to the mixture over a period of 5 mins and stir at room temperature for 20 hours. Evaporate the 15 solvent from reaction mixture under vacuum and purify by flash column chromatography using CHCl<sub>3</sub> to afford yellow oil.

Part E: Title compound:



20 Dissolve Part D material of example 4 (0.120 g, 0.262 mmoles) in EtOH(25.0 mL) at room temperature. Add 5 % Pd/C (30 mg) and hydrogenate at 5 atm. of H<sub>2</sub> for 5 hours at room temperature. Filter the catalyst, evaporate the solvent from reaction

mixture under vacuum and purify by PTLC using 5 % MeOH / CHCl<sub>3</sub> to afford yellow oil.

5 NMR (CDCl<sub>3</sub>): δ 1.38-1.41 (d, 3H), 1.45-1.47 (d, 3H), 3.05-3.11 (m, 1H), 3.22-3.62 (m, 4H), 3.85-3.90 (m, 1H), 4.35-4.42 (m, 1H), 6.40 (s, 1H), 7.05-7.10 (m, 1H), 7.21-7.40 (m, 5H), 7.95-7.97 (d, 1H), 8.42-8.46 (d, 1H).

10 Mass spectrum (ESI): 461.3 (M+H).

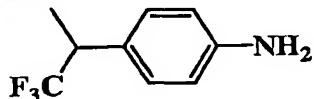
10

Example 5

4-(3-Chloro-pyridin-2-yl)-2-methyl-piperazine-1-carboxylic acid  
[4-(2,2,2-trifluoro-1-methyl-ethyl)-phenyl]-amide

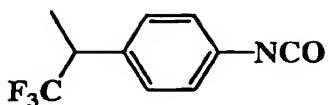
15

Part A: Synthesis of 4-(2,2,2-Trifluoro-1-methyl-ethyl)-phenylamine



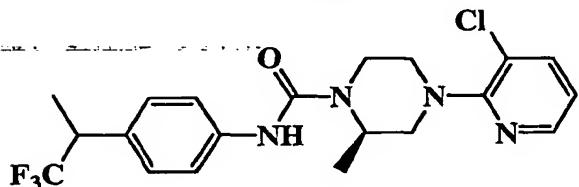
20 Dissolve Part B material of example 4 (0.375 g, 0.262 mmoles) in MeOH(25.0 mL) at room temperature. Add raney Ni (500 mg) and hydrogenate at 40 atm. of H<sub>2</sub> for 20 hours at room temperature. Filter the catalyst, evaporate the solvent from reaction mixture under vacuum and purify by flash column chromatography  
25 using CHCl<sub>3</sub> to afford yellow oil.

Part B: Synthesis of 1-Isocyanato-4-(2,2,2-trifluoro-1-methyl-ethyl)-benzene



Cool 20 % phosgene in toluene (2.0 mL) to -40 °C under N<sub>2</sub> atmosphere. Dissolve Part A material of Example 5 (0.189 g, 1.0 mmole) in toluene and add drop wise to the cooled stirred solution. Stir at -40 °C for 30 mins followed by room temperature for 3 h and then at reflux for 18 h. Concentrate in vacuo to afford yellow liquid.

10 Part C: Title compound:



Dissolve Part A material of example 1 (0.169 g, 0.795 mmoles) in toluene (1.0 mL) under nitrogen at room temperature. Add 15 drop wise Part B material of Example 5 (0.171 g, 0.795 mmoles) dissolved in toluene (1.0 mL) to the mixture over a period of 5 mins and stir at room temperature for 20 hours. Evaporate the solvent from reaction mixture under vacuum and purify by PTLC using 5 % MeOH / CHCl<sub>3</sub> to afford white amorphous powder.

20

NMR (CDCl<sub>3</sub>): δ 1.44-1.49 (2d, 6H), 2.94-3.11 (m, 2H), 3.36-3.51 (m, 2H), 3.74-3.94 (m, 3H), 4.35-4.37 (m, 1H), 6.41 (s, 1H), 6.87-6.90 (dd, 1H), 7.23-7.26 (m, 2H), 7.36-7.38 (m, 2H), 7.60-7.63 (dd, 1H), 8.19-8.20 (dd, 1H).

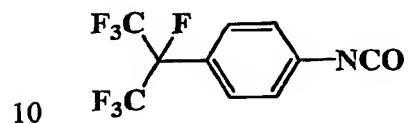
25

Mass spectrum (ESI): 427.3 (M+H).

### Example 6

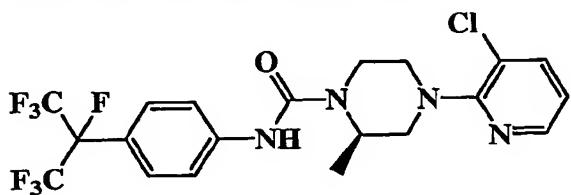
(R)-4-(3-Chloro-pyridin-2-yl)-2-methyl-piperazine-1-carboxylic acid [4-(1,2,2,2-tetrafluoro-1-trifluoromethyl-ethyl)-phenyl]-amide

• Part A: Synthesis of 1-Isocyanato-4-(1,2,2,2-tetrafluoro-1-trifluoromethyl-ethyl)-benzene



Cool 20 % phosgene in toluene (20.0 mL) to -40 °C under N<sub>2</sub> atmosphere. Dissolve 4-heptafluoroisopropylaniline (2.0 g, 7.7 mmoles; see: EP 1006102 for aniline preparation) in toluene (5.0 mL) and add drop wise to the cooled stirred solution. Stir at -40 °C for 30 mins followed by room temperature for 2 h and then at reflux for 4 h. Concentrate in vacuo to afford yellow liquid.

20 Part B: Title compound:



Dissolve Part A material of example 1 (0.106 g, 0.795 mmoles) in toluene (1.0 mL) under nitrogen at room temperature. Add drop wise Part A material of Example 6 (0.144 g, 0.5 mmoles) dissolved in toluene (1.0 mL) to the mixture over a period of 5 mins and stir at room temperature for 20 hours. Evaporate the

solvent from reaction mixture under vacuum and purify by PTLC using 5 % MeOH / CHCl<sub>3</sub> to afford white amorphous powder.

5 NMR (CDCl<sub>3</sub>):  $\delta$  1.44-1.46 (d, 3H, J=1.6 Hz), 2.93-3.10 (m, 2H), 3.45-3.52 (m, 1H), 3.74-3.78 (m, 2H), 3.91-3.94 (m, 1H), 4.37-4.38 (m, 1H), 6.60 (s, 1H), 6.87-6.90 (dd, 1H), 7.52-7.60 (m, 4H), 7.61-7.63 (m, 1H), 8.18-8.20 (dd, 1H).

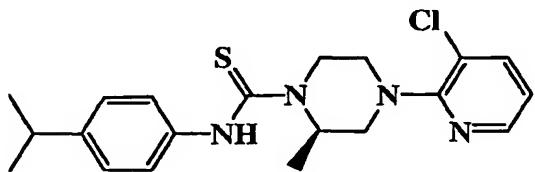
Mass spectrum (ESI): 499.2 (M+H).

10

Example 7

14-(3-Chloro-pyridin-2-yl)-2-methyl-piperazine-1-carbothioic acid (4-isopropyl-phenyl)-amide

15



20 Dissolve Part A material of example 1 (0.212 g, 1.0 mmoles) in toluene (1.0 mL) under nitrogen at room temperature. Add drop wise 4-isopropylisothiocyanate (0.177 g, 0.5 mmoles) dissolved in toluene (1.0 mL) to the mixture over a period of 5 mins and stir at room temperature for 20 hours. Evaporate the solvent from reaction mixture under vacuum and purify by flash column chromatography using CHCl<sub>3</sub> to afford white solid (mp 49-51 °C).

25

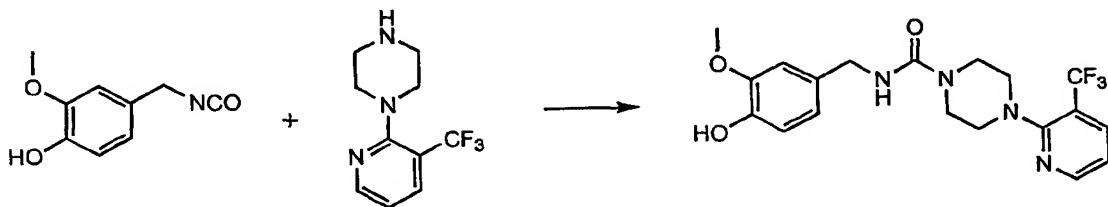
NMR (CDCl<sub>3</sub>):  $\delta$  1.22-1.25 (d, 3H), 1.41-1.43 (d, 3H), 2.80-3.20 (m, 3H), 3.45-3.60 (m, 1H), 3.65-3.80 (m, 2H), 4.35-4.39 (m, 1H), 5.05-5.20 (m, 1H), 6.85-6.90 (s, 1H), 7.15-7.35 (m, 5H), 7.42-7.44 (d, 1H), 8.18-8.20 (d, 1H).

Mass spectrum (ESI): 387.2 (M+H).

Example 8

5

Synthesis of 4-(3-Trifluoromethyl-2-pyridinyl)-N-(3-methoxy-4-hydroxyphenylmethyl)-1-piperazinecarboxamide



10

A quantity of 0.2 mL of a 0.2 M isocyante solution in dichloroethane is treated with 0.26 mL of a 0.2 mL solution of piperazine in 95:5 toluene: N-Methyl Morphine at 60 °C for 16 hr. The resulting reaction solution was cooled to room

15 temperature. To the resulting solution is added 1 drop of amino propyl morpholine and warmed to 60 °C for an additional hour. The resulting mixture is cooled to room temperature and chromatographed SiO<sub>2</sub> with ethyl acetate to afford 10 mg 63% of the title compound (Compound 1). MS m/z 410.16 found: 411, 433  
20 Na adduct. Capsaicin receptor K<sub>i</sub>: 366nM

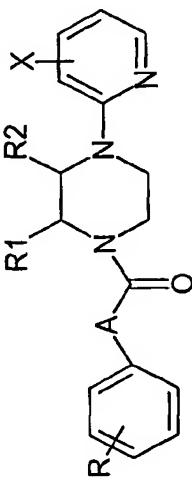
Example 9

Additional compounds

Using variations of the methods given in Schemes 1 and 2, 25 and Examples 1-8 that will be readily apparent to one skilled in the art of organic synthesis the compounds list in Tables II, III and IV are prepared. Commercial grade reagents are

used without further purification in the preparation of these compound

TABLE II



Compound	R	R1	R2	A	X	Calc	Found	Activity	Chemical Name
2	4-Butyl	H	H	NH	3-NO <sub>2</sub>	383	384, 406 Na adduct	*	4-(3-Nitro-2-pyridinyl)-N-[4-(n-butyl)phenyl]-1-piperazinecarboxamide
3	4-Butyl	H	H	NH	3-CF <sub>3</sub>	406	407, 429 Na adduct	*	4-(3-Trifluoromethyl-2-pyridinyl)-N-[4-(n-butyl)phenyl]-1-piperazinecarboxamide
4	4- Isoprop yl	H	H	NH	3-Me	338	339, 361 Na adduct	*	4-(3-Methyl-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide
5	4-Butyl	H	H	NH	3-Me	352	353, 375 Na adduct	NA	4-(3-Methyl-2-pyridinyl)-N-[4-(n-butyl)phenyl]-1-piperazinecarboxamide
6	4- Isoprop yl	H	H	NH	3-CF <sub>3</sub>	352	353, 375 Na adduct	*	4-(3-Trifluoromethyl-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide
7	4- Isoprop yl	H	H	NH	3-Cl, 5- CF <sub>3</sub>	427	427, 449 Na adduct	*	4-(3-Chloro-5-trifluoromethyl-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide

8	4- Isoprop yl	H	H	NH	3-Cl	359	359, 381 Na adduct	*	4-(3-Chloro-2-pyridinyl)-N-[4- (isopropyl)phenyl]-1- piperazinecarboxamide
9	4- Isoprop yl	H	H	NH	3,5- dicl	393	393, 415 Na adduct	*	4-(3,5-Dichloro-2-pyridinyl)-N-[4- (isopropyl)phenyl]-1- piperazinecarboxamide
10	4- Isoprop yl	H	H	CH=CH	3-CF3			*	1-(3-Methyl-2-pyridinyl)-3-(4- trifluoromethyl phenyl)-prop-2-en-1-one
11	4-CF3	H	H	CH=CH	3-Me			*	1-(3-TriFluoromethyl-2-pyridinyl)-3-(4- isopropylphenyl)-prop-2-en-1-one
12	4- Isoprop yl	H	H	NH	3-CN	349		*	4-(3-Cyano-2-pyridinyl)-N-[4- (isopropyl)phenyl]-1- piperazinecarboxamide
13	4- Isoprop yl	Me	H	NH	3-Cl	373	373, 395 Na adduct	NA	4-(3-Chloro-2-pyridinyl)-N-[4- (isopropyl)phenyl]-2-methyl-1- piperazinecarboxamide
14	4- Isoprop yl	R- Me	H	NH	3-Cl	373	373, 395 Na adduct	*	4-(3-Chloro-2-pyridinyl)-2-methylthio-1- piperazinecarboxamide
15	4- Isoprop yl	S- Me	H	NH	3-Cl	373	373, 395 Na adduct	NA	4-(3-Chloro-2-pyridinyl)-N-[4- (isopropyl)phenyl]-2-methylthio-1- piperazinecarboxamide
16	4-CF3	H	H	NH	3,5- dicl	373		NA	4-(3,5-Dichloro-2-pyridinyl)-N-[4- (isopropyl)phenyl]-1- piperazinecarboxamide

\* indicates a  $K_i$  value of less than 4  $\mu\text{M}$  in a Capsaicin receptor binding assay  
A Capsaicin receptor binding assay is described in example 10  
NA = Not available

Mass spec data are collected using a MicroMass 60 series (Beverly, MA) LC-MS TOF spectrometer in the electrospray mode.

LC conditions: YMC-pack pro C18 column, 33 x 4.6 ID, Particle size: 5-5  $\mu\text{m}$  120A, supplied by WATERS, Milford, MA, 95%- 5% gradient, 2 min gradient time, flow rate 3.5 ml/min, Mobile Phase: A: 0.05% TFA in H<sub>2</sub>O/MeOH (95:5 v/v) B: 0.05% TFA IN MeOH/H<sub>2</sub>O(95:5 v/v), 1 ul injection volume .

Table III

Cmp. #	STRUCTURE	IUPAC Name	EC50
17		N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)piperazine-1-carboxamide	*
18		(2R)-4-(3-chloropyridin-2-yl)-N-(4-cyclohexylphenyl)-2-methylpiperazine-1-carboxamide	*
19		(2R)-4-(3-chloropyridin-2-yl)-N-[2-chloro-4-(trifluoromethyl)phenyl]-2-methylpiperazine-1-carboxamide	
20		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
21		(2R)-N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
22		(2R)-4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide	*
23		(2S)-4-(3-chloropyridin-2-yl)-N-(4-trifluoromethylphenyl)-2-methylpiperazine-1-carboxamide	*

24		(2S)-N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
25		(2S)-4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide	*
26		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-(4-piperidin-1-ylphenyl)piperazine-1-carboxamide	*
27		(2R)-4-(3-chloropyridin-2-yl)-N-[2-fluoro-4-(trifluoromethyl)phenyl]-2-methylpiperazine-1-carboxamide	*
28		(2R)-2-methyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
29		(2R)-N-(4-tert-butylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

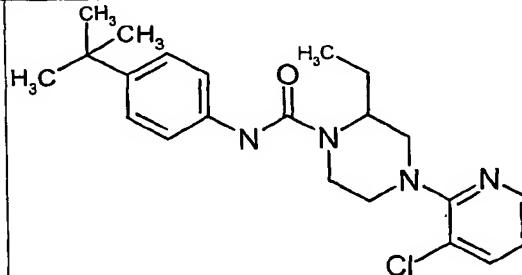
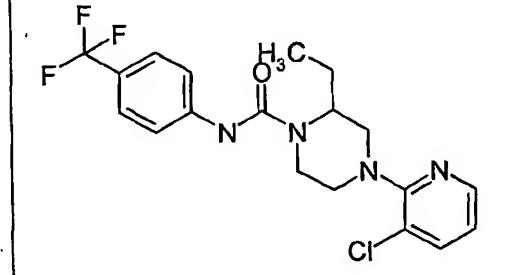
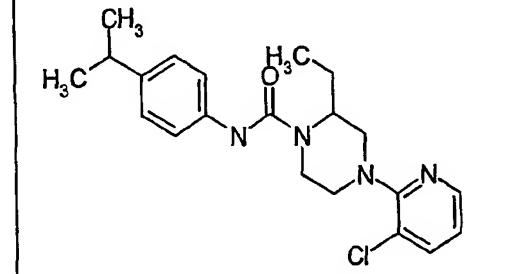
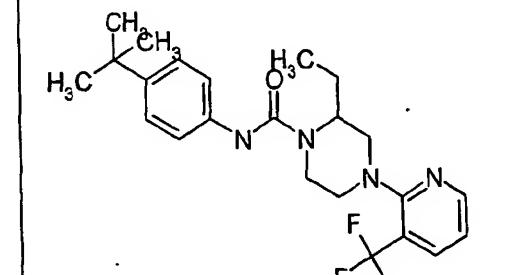
30		(2R)-N-(4-isopropylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
31		4-(3-chloropyridin-2-yl)-2,6-dimethyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
32		N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2,6-dimethylpiperazine-1-carboxamide	*
33		4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)-2,6-dimethylpiperazine-1-carboxamide	*
34		(2R)-N-(4-cyclohexylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
35		4-(3-chloropyridin-2-yl)-N-(4-cyclohexylphenyl)-2,6-dimethylpiperazine-1-carboxamide	*
36		(2R)-4-(3-chloropyridin-2-yl)-N-(4-cyclopentylphenyl)-2-methylpiperazine-1-carboxamide	*

37		(2R)-N-(4-cyclopentylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
38		(2R)-4-isoquinolin-1-yl-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
39		(2R)-N-(4-tert-butylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide	*
40		(2R)-N-(4-isopropylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide	*
41		(2R)-N-(4-cyclopentylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide	*
42		(2R)-N-(4-cyclohexylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide	*

43		(2R)-N-(4-tert-butylphenyl)-4-[3-(dimethylamino)pyridin-2-yl]-2-methylpiperazine-1-carboxamide	*
44		(2R)-4-[3-(dimethylamino)pyridin-2-yl]-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
45		(2R)-N-(4-tert-butylphenyl)-4-(3-methoxypyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
46		(2R)-4-(3-methoxypyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	
47		(2R)-N-(4-cyclohexylphenyl)-4-(3-methoxypyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
48		(2R)-4-(3-chloropyridin-2-yl)-N-[4-(3,6-dihydro-2H-pyran-4-yl)phenyl]-2-methylpiperazine-1-carboxamide	*

49		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-(4-tetrahydro-2H-pyran-4-ylphenyl)piperazine-1-carboxamide	*
50		(2R)-4-(3-chloropyridin-2-yl)-N-[4-(4-hydroxytetrahydro-2H-pyran-4-yl)phenyl]-2-methylpiperazine-1-carboxamide	*
51		(2R)-N-[4-(4-hydroxytetrahydro-2H-pyran-4-yl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
52		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-(2-methyl-1,3-thiazol-4-yl)phenyl)piperazine-1-carboxamide	*

53		(2R)-4-(3-chloropyridin-2-yl)-N-[4-(2-ethyl-1,3-thiazol-4-yl)phenyl]-2-methylpiperazine-1-carboxamide	*
54		(2R)-4-(3-chloropyridin-2-yl)-N-[4-(2-methoxy-1,1-dimethylethyl)phenyl]-2-methylpiperazine-1-carboxamide	*
55		(2R)-N-[4-(2-methoxy-1,1-dimethylethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
56		(2R)-4-(3-chloropyridin-2-yl)-N-[4-(1-cyano-1-methylethyl)phenyl]-2-methylpiperazine-1-carboxamide	*
57		(2R)-N-[4-(1-cyano-1-methylethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

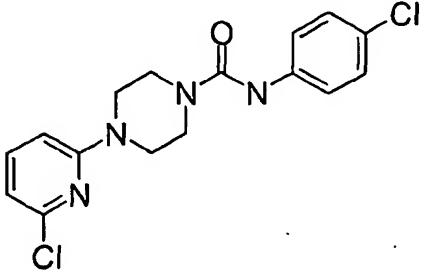
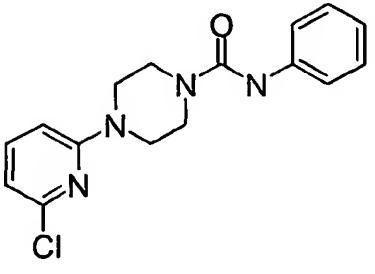
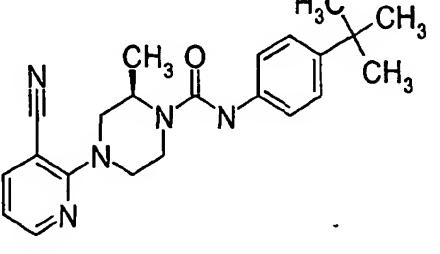
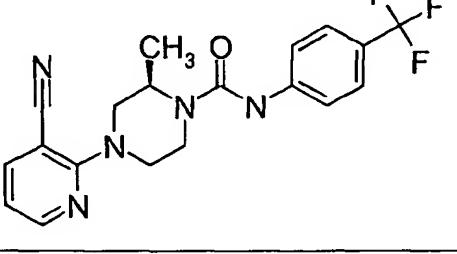
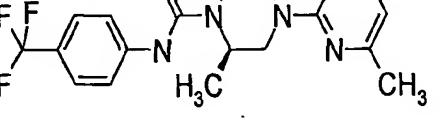
58		N- (4-tert-butylphenyl) -4- (3-chloropyridin-2-yl) -2- ethylpiperazine-1- carboxamide	*
59		4- (3-chloropyridin-2-yl) - 2-ethyl-N- [4- (trifluoromethyl)phenyl]pi perazine-1-carboxamide	*
60		4- (3-chloropyridin-2-yl) - 2-ethyl-N- (4- isopropylphenyl)piperazine -1-carboxamide	*
61		N- (4-tert-butylphenyl) -2- ethyl-4- [3- (trifluoromethyl)pyridin- 2-yl]piperazine-1- carboxamide	*

62		2-ethyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
63		2-ethyl-N-(4-isopropylphenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
64		2-tert-butyl-N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)piperazine-1-carboxamide	*
65		2-tert-butyl-4-(3-chloropyridin-2-yl)-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	

66		2-tert-butyl-4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)piperazine-1-carboxamide	
67		2-tert-butyl-N-(4-tert-butylphenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	
68		2-tert-butyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
69		N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2-isopropylpiperazine-1-carboxamide	*

70		4-(3-chloropyridin-2-yl)- 2-isopropyl-N-[4- (trifluoromethyl)phenyl]pi- perazine-1-carboxamide	
71		4-(3-chloropyridin-2-yl)- 2-isopropyl-N-(4- isopropylphenyl)piperazine -1-carboxamide	
72		N-(4-tert-butylphenyl)-2- isopropyl-4-[3- (trifluoromethyl)pyridin- 2-yl]piperazine-1- carboxamide	*
73		2-isopropyl-N-[4- (trifluoromethyl)phenyl]- 4-[3-(trifluoromethyl) pyridin-2-yl]piperazine-1- carboxamide	*

74		2-isopropyl-N-(4-isopropylphenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
75		(2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
76		(2R)-N-(4-tert-butylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
77		(2R)-4-(3-fluoropyridin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide	*
78		(2R)-N-(4-cyclohexylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
79		(2R)-N-(4-cyclopentylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*

80		N-(4-chlorophenyl)-4-(6-chloropyridin-2-yl)piperazine-1-carboxamide	
81		4-(6-chloropyridin-2-yl)-N-phenylpiperazine-1-carboxamide	
82		(2R)-N-(4-tert-butylphenyl)-4-(3-cyanopyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
83		(2R)-4-(3-cyanopyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
84		(2R)-2-methyl-4-(6-methylpyridin-2-yl)-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	

85		(2R)-4-(6-methoxypyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	
86		(2R)-N-(4-tert-butylphenyl)-2-methyl-4-(6-methylpyridin-2-yl)piperazine-1-carboxamide	*
87		(2R)-N-(4-tert-butylphenyl)-4-(6-methoxypyridin-2-yl)-2-methylpiperazine-1-carboxamide	
88		(2R)-N-(4-isopropylphenyl)-2-methyl-4-(6-methylpyridin-2-yl)piperazine-1-carboxamide	
89		(2R)-N-(4-isopropylphenyl)-4-(6-methoxypyridin-2-yl)-2-methylpiperazine-1-carboxamide	

90		(2R)-N-(4-cyclopentylphenyl)-2-methyl-4-(6-methylpyridin-2-yl)piperazine-1-carboxamide	
91		(2R)-N-(4-cyclopentylphenyl)-4-(6-methoxypyridin-2-yl)-2-methylpiperazine-1-carboxamide	

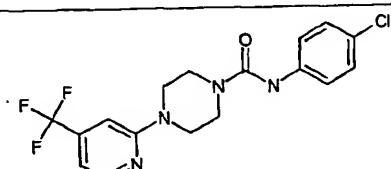
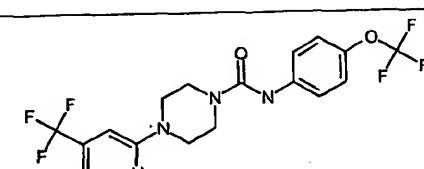
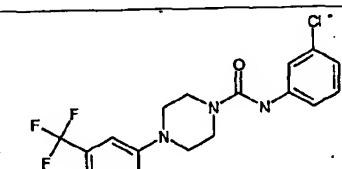
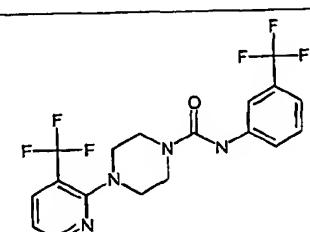
TABLE IV

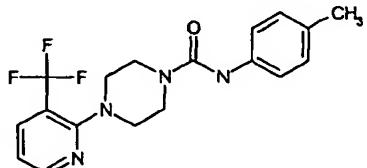
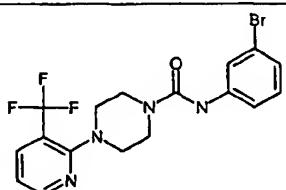
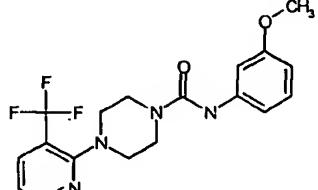
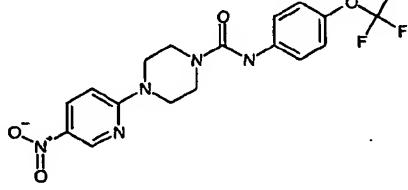
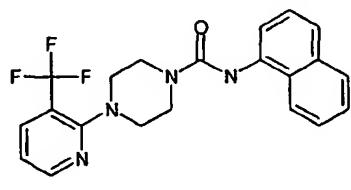
Cpd. #	STRUCTURE	IUPAC Name	EC50
93		4-(3-chloropyridin-2-yl)-N-[5-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
94		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[5-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

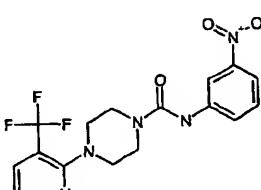
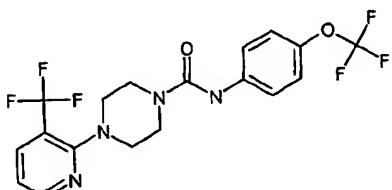
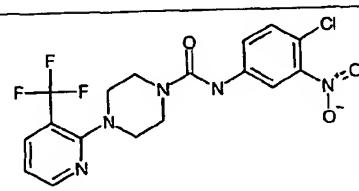
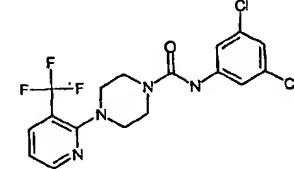
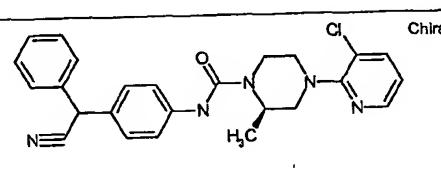
95		(2R)-N-(4-tert-butylphenyl)-4-(3-chloropyrazin-2-yl)-2-methylpiperazine-1-carboxamide	*
96		(2R)-4-(3-chloropyrazin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide	*
97		(2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
98		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[6-(trifluoromethyl)pyridin-3-yl]piperazine-1-carboxamide	*
99		(2R)-N-(4-tert-butylcyclohexyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
100		(2R)-4-(3-chloropyridin-2-yl)-N-(4-isopropylcyclohexyl)-2-methylpiperazine-1-carboxamide	*

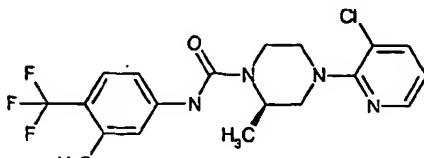
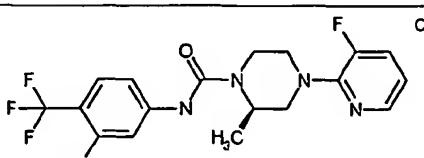
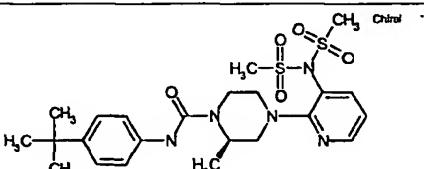
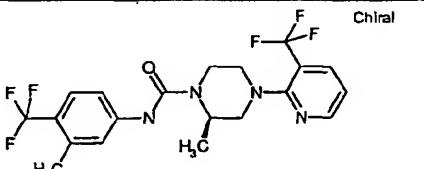
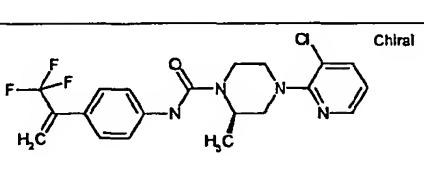
101		(2R)-N-(4-isopropylcyclohexyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
102		(2R)-4-isquinolin-1-yl-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	
103		(2R)-N-(4-tert-butylphenyl)-4-isquinolin-1-yl-2-methylpiperazine-1-carboxamide	
104		(2R)-N-(4-isopropylphenyl)-4-isquinolin-1-yl-2-methylpiperazine-1-carboxamide	
105		(2R)-N-(4-cyclopentylphenyl)-4-isquinolin-1-yl-2-methylpiperazine-1-carboxamide	
106		(2R)-N-(4-cyclohexylphenyl)-4-isquinolin-1-yl-2-methylpiperazine-1-carboxamide	

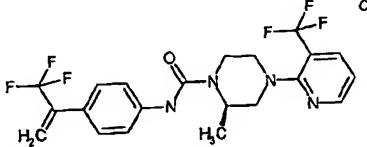
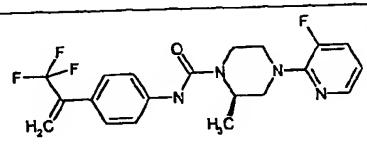
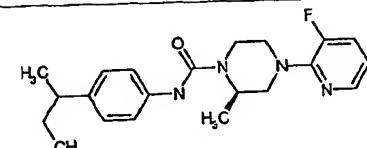
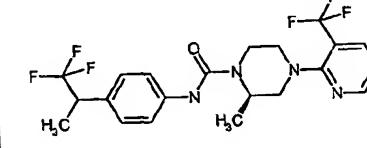
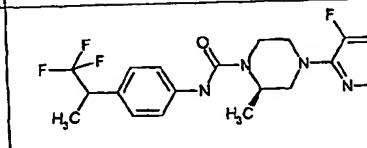
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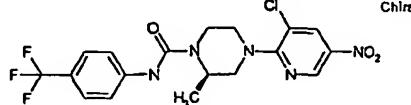
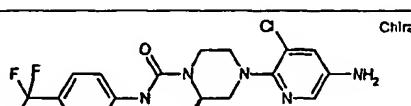
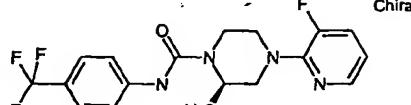
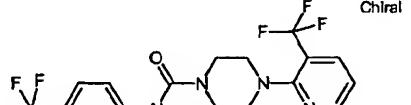
Cmp #	Structure	Name	EC50
107		N- (4-chlorophenyl)-4-[4-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
108		N- [4-(trifluoromethoxy)phenyl]-4-[4-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
109		N- (3-chlorophenyl)-4-[4-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
110		N- [3-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

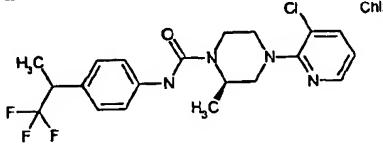
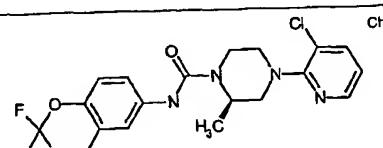
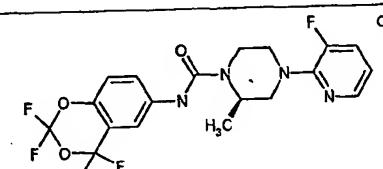
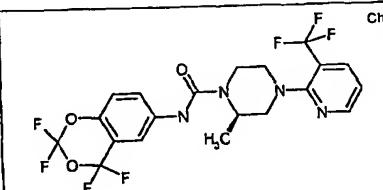
111		N-(4-methylphenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	
112		N-(3-bromophenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	
113		N-(3-methoxyphenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
114		4-(5-nitropyridin-2-yl)-N-[4-(trifluoromethoxy)phenyl]piperazine-1-carboxamide	
115		N-(1-naphthyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	

116		N-(3-nitrophenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
117		N-[4-(trifluoromethoxy)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
118		N-(4-chloro-3-nitrophenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
119		N-(3,5-dichlorophenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
120		(2R)-4-(3-chloropyridin-2-yl)-N-{4-[cyano(phenyl)methyl]phenyl}-2-methylpiperazine-1-carboxamide	*

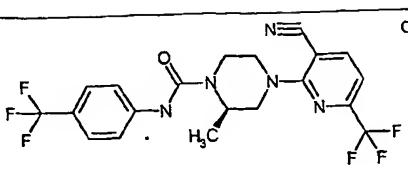
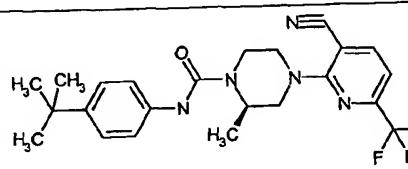
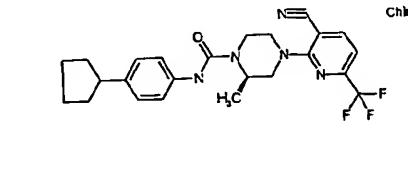
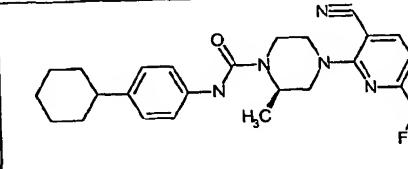
121	 Chiral	(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[3-methyl-4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
122	 Chiral	(2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[3-methyl-4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
123	 Chiral	(2R)-4-{3-[bis(methylsulfonyl)amino]pyridin-2-yl}-N-(4-tert-butylphenyl)-2-methylpiperazine-1-carboxamide	*
124	 Chiral	(2R)-2-methyl-N-[3-methyl-4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
125	 Chiral	(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-[1-(trifluoromethyl)vinyl]phenyl]piperazine-1-carboxamide	*

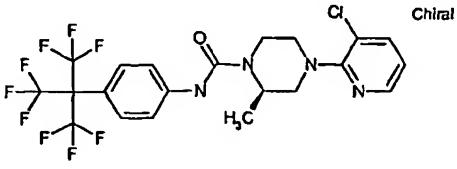
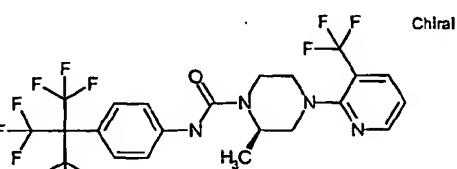
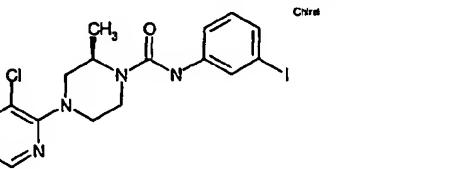
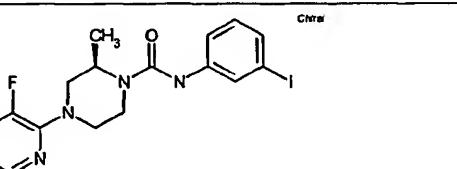
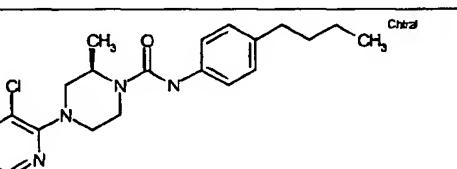
126		(2R)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]-N-[4-(1-(trifluoromethyl)vinyl)phenyl]piperazine-1-carboxamide	*
127		(2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[4-(1-(trifluoromethyl)vinyl)phenyl]piperazine-1-carboxamide	*
128		(2R)-N-(4-sec-butylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
129		(2R)-2-methyl-N-[4-(2,2,2-trifluoro-1-methylethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
130		(2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[4-(2,2,2-trifluoro-1-methylethyl)phenyl]piperazine-1-carboxamide	*

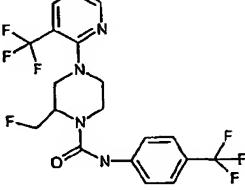
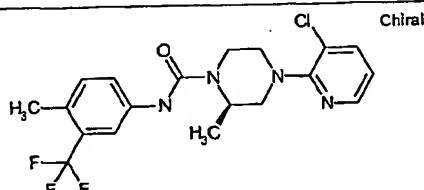
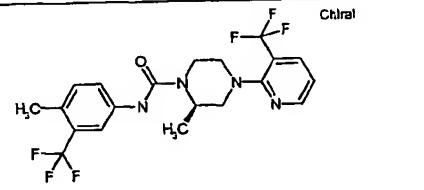
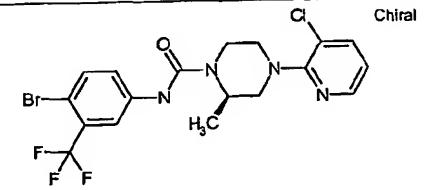
131		(2R)-4-(3-chloro-5-nitropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
132		(2R)-4-(5-amino-3-chloropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
133		(2R)-4-(3-fluoropyridin-2-yl)-N-[3-fluoro-4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
134		(2R)-N-[3-fluoro-4-(trifluoromethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

135		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-(2,2,2-trifluoroethyl)phenyl]piperazine-1-carboxamide	*
136		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-(2,2,4,4-tetrafluoro-4H-1,3-benzodioxin-6-yl)piperazine-1-carboxamide	*
137		(2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-(2,2,4,4-tetrafluoro-4H-1,3-benzodioxin-6-yl)piperazine-1-carboxamide	*
138		(2R)-2-methyl-N-(2,2,4,4-tetrafluoro-4H-1,3-benzodioxin-6-yl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

139		(2R)-4-[3-(aminosulfonyl)pyridin-2-yl]-N-(4-tert-butylphenyl)-2-methylpiperazine-1-carboxamide	*
140		(2R)-N-(4-benzoylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*
141		(2R)-4-(3-chloropyridin-2-yl)-N-(4-iodophenyl)-2-methylpiperazine-1-carboxamide	*
142		(2R)-4-(3-chloropyridin-2-yl)-N-(9H-fluoren-2-yl)-2-methylpiperazine-1-carboxamide	*
143		(2R)-N-(9H-fluoren-2-yl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

144		(2R)-4-[3-cyano-6-(trifluoromethyl)pyridin-2-yl]-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide	
145		(2R)-N-(4-tert-butylphenyl)-4-[3-cyano-6-(trifluoromethyl)pyridin-2-yl]-2-methylpiperazine-1-carboxamide	
146		(2R)-4-[3-cyano-6-(trifluoromethyl)pyridin-2-yl]-N-(4-cyclopentylphenyl)-2-methylpiperazine-1-carboxamide	
147		(2R)-4-[3-cyano-6-(trifluoromethyl)pyridin-2-yl]-N-(4-cyclohexylphenyl)-2-methylpiperazine-1-carboxamide	

148		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-{4-[2,2,2-trifluoro-1,1-bis(trifluoromethyl)ethyl]phenyl}piperazine-1-carboxamide	*
149		(2R)-2-methyl-N-{4-[2,2,2-trifluoro-1,1-bis(trifluoromethyl)ethyl]phenyl}-4-(trifluoromethyl)pyridin-2-yl)piperazine-1-carboxamide	*
150		(2R)-4-(3-chloropyridin-2-yl)-N-(3-iodophenyl)-2-methylpiperazine-1-carboxamide	*
151		(2R)-4-(3-fluoropyridin-2-yl)-N-(3-iodophenyl)-2-methylpiperazine-1-carboxamide	*
152		(2R)-N-(4-butylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*

153		2-(fluoromethyl)-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
154		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-methyl-3-(trifluoromethyl)phenyl]piperazine-1-carboxamide	*
155		(2R)-2-methyl-N-[4-methyl-3-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
156		(2R)-N-[4-bromo-3-(trifluoromethyl)phenyl]-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide	*

157		(2R)-N-[4-bromo-3-(trifluoromethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
158		(2R)-4-(3-chloropyridin-2-yl)-N-[4-chloro-3-(trifluoromethyl)phenyl]-2-methylpiperazine-1-carboxamide	*
159		(2R)-4-(3-chloropyridin-2-yl)-N-[4-fluoro-3-(trifluoromethyl)phenyl]-2-methylpiperazine-1-carboxamide	*
160		(2R)-N-[4-chloro-3-(trifluoromethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

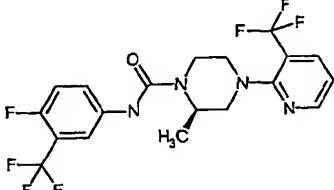
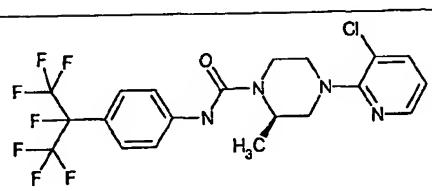
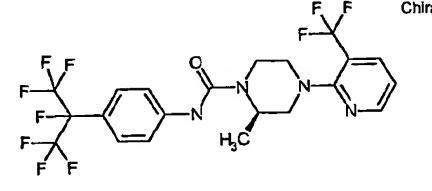
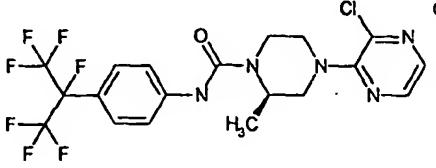
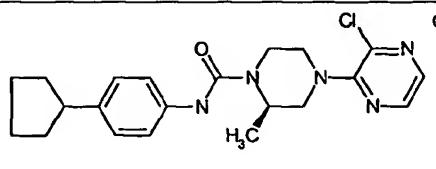
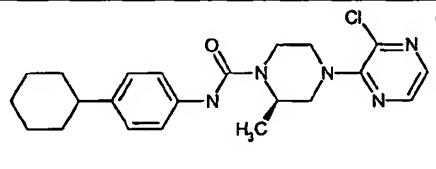
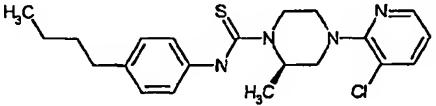
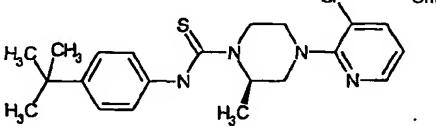
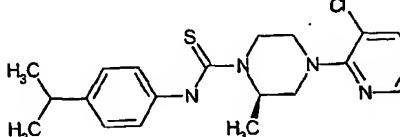
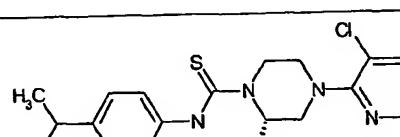
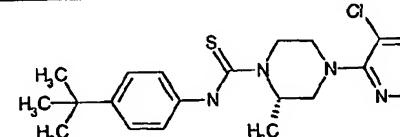
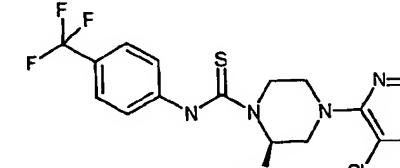
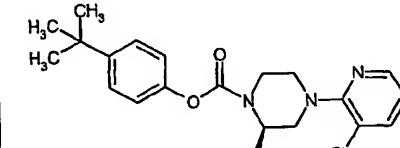
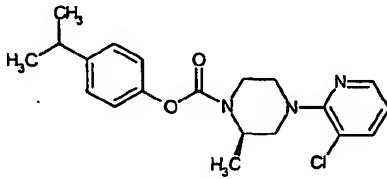
161		(2R)-N-[4-fluoro-3-(trifluoromethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*
162		(2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl}piperazine-1-carboxamide	*
163		(2R)-2-methyl-N-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl}-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide	*

Table VI

Cmp. #	Structure	NAME	EC50

164		(2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl}piperazine-1-carboxamide	*
165		(2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-{4-cyclopentyl-phenyl}piperazine-1-carboxamide	*
166		(2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-{4-cyclohexyl-phenyl}piperazine-1-carboxamide	*
167			*
168			*

169	 Chiral		*
170	 Chiral		*
171	 Chiral		*
172	 Chiral		*
173	 Chiral		*

174	 <i>Chiral</i>		
<p>* in Table III - Table VI indicates a EC50 value of less than 1 uM in an antagonist assay for Capsaicin receptor mediated calcium mobilization.</p> <p>An assay for Capsaicin receptor mediated calcium mobilization is described in example 11</p>			

### Example 10

#### Capsaicin Receptor Binding Assay

The following assay is a standard assay of capsaicin receptor binding that may be used to determine the binding affinity of compounds for the capsaicin (VR1) receptor.

Materials. [<sup>3</sup>H]Resiniferatoxin (RTX; 37 Ci/mmol) was synthesized by and obtained from the Chemical Synthesis and Analysis Laboratory, National Cancer Institute-Frederick Cancer Research and Development Center, Frederick, MD. [<sup>3</sup>H] RTX may also be obtained from commercial vendors, e.g., Amersham Pharmacia Biotech, Inc. 800 Centennial Avenue, P.O. Box 1327, Piscataway, NJ 08855 (code TRK 1069). Nonradioactive RTX may be purchased from Alexis Corp. (San Diego, CA) and capsazepine from RBI (Natick, MA).

#### Molecular Biology

A cDNA encoding the full length human capsaicin receptor (SEQ ID NO:1 or SEQ ID NO:2) is subcloned in the appropriate orientation for expression into an expression vector such as pcDNA3.1 (Invitrogen, Carlsbad, CA) or pUHG102-3 (Clontech, Palo Alto, CA) for recombinant expression in mammalian cells.

Cell Culture. Human embryonic kidney (HEK293) cells are transfected with a pcDNA3.1 expression construct encoding the full length human capsaicin receptor (i.e. containing either the nucleotide sequence of SEQ ID NO:1 and SEQ ID NO:2) using 5 standard methods. These transfected cells are selected for two weeks in media containing G418 (400 ug/ml) and then maintained as a pool of stably transfected cells.

pUHG102 VR1 expression plasmids are transfected into Chinese Hamster Ovary (CHO) cells containing the pTet Off 10 Regulator plasmid (Clontech). In these cells, expression of the pUHG plasmid is repressed in the presence of tetracycline but is induced upon removal of the antibiotic. Stable clones are isolated in culture medium containing puromycin (10 ug/ml) and maintained in medium supplemented with tetracycline (1 ug/ml). 15 Cells utilized for assays are grown in culture medium without antibiotic for 48-72 hours prior to use. For radioligand binding experiments, cells are seeded in T175 cell culture flasks in media without antibiotics and grown to approximately 90% confluency. The flasks are then washed with PBS and 20 harvested in PBS containing 5 mM EDTA. The cells are pelleted by gentle centrifugation and stored at -80°C until assayed.

#### Membrane Preparations

Previously frozen cells are disrupted with the aid of a tissue homogenizer in ice-cold HEPES homogenization buffer (5mM 25 KCl 5, 5.8mM NaCl, 0.75mM CaCl<sub>2</sub>, 2mM MgCl<sub>2</sub>, 320 mM sucrose, and 10 mM HEPES pH 7.4). Tissue homogenates are first centrifuged for 10 min at 1000 x g (4 °C) to remove the nuclear fraction and debris and then the supernatant from the first centrifugation is further centrifuged for 30 min at 35,000 x g (4°C) to obtain 30 a partially purified membrane fraction. Membranes are resuspended in the HEPES homogenization buffer prior to being

assayed. An aliquot of this membrane homogenate is used to determine protein concentration via the Bradford method (BIO-RAD Protein Assay Kit, #500-0001, BIO-RAD, Hercules, CA).

Radioligand Binding

5 Binding studies with [<sup>3</sup>H]RTX are carried out essentially according to a published protocol (Szallasi and Blumberg, 1992, *J. Pharmacol. Exp. Ter.* 262: 883-888) in which non-specific RTX binding is reduced by adding bovine alpha<sub>1</sub> acid glycoprotein (100 ug per tube) after the binding reaction has been  
10 terminated. The homogenate is centrifuged as before and resuspended to a protein concentration of 333ug/ml in homogenization buffer. Binding assay mixtures were set up on  
- ice and contained [<sup>3</sup>H]RTX (specific activity 2200 mCi/ml), 2. ul non-radioactive ligands test compound, 0.25 mg/ml bovine serum  
15 albumin (Cohn fraction V), and 5 x 10<sup>4</sup> - 1 x 10<sup>5</sup> VR1-transfected cells. The final volume was adjusted to 500 ul (competition binding assays) or 1,000 ul (saturation binding assays) with the ice-cold HEPES homogenization buffer solution (pH 7.4) described above. Non-specific binding was defined as that  
20 occurring in the presence of 1 uM non-radioactive RTX. For saturation binding, [<sup>3</sup>H]RTX was added in the concentration range of 7 - 1,000 pM, using 1 to 2 dilutions. Typically 11 concentration points are collected per saturation binding curve.

25 Competition binding assays were performed in the presence of 60 pM [<sup>3</sup>H]RTX and various concentrations of competing ligands. The binding reactions are initiated by transferring the assay mixtures into a 37°C water bath and are terminated following a 60 min incubation period by cooling the tubes on  
30 ice. Membrane-bound RTX is separated from free, as well as any alpha<sub>1</sub>-acid glycoprotein-bound RTX, by filtration onto WALLAC

glass fiber filters (PERKIN-ELMER, Gaithersburg, MD) which are pre-soaked with 1.0% PEI (polyethyleneimine) for 2 hours prior to use. Filters are allowed to dry overnight then counted in a WALLAC 1205 BETA PLATE counter after addition of WALLAC BETA SCINT scintillation fluid.

Equilibrium binding parameters were determined by fitting the allosteric Hill equation to the measured values with the aid of the computer program FIT P (Biosoft, Ferguson, MO) as described previously (Szallasi, et al. (1993) *J. Pharmacol. 10 Exp. Ther.* 266:678 -683)).

Though compounds exhibiting  $K_i$  values for capsaicin receptors of greater than 1  $\mu M$  are generally less preferred as pharmaceutical agents, useful compounds of the invention exhibit  $K_i$  values for capsaicin receptors of less than 4  $\mu M$ , more preferred compounds exhibit  $K_i$  values of less than 1  $\mu M$ , even more preferred compounds exhibit  $K_i$  values of less than 100 nM, more highly preferred compounds exhibit  $K_i$  values of less than 50 nM, even more highly preferred compounds exhibit  $K_i$  values of less than 25 nM and the most preferred compounds of the invention yield  $K_i$  values of less than or about equal to 10 nM in this assay.

#### Example 11

##### Calcium Mobilization Assay

The following assay can be used to monitor the response of cells capsaicin receptors to capsaicin and other vanilloid ligands of the capsaicin receptor. The assay can also be used to determine if test compounds act as agonists or antagonists of capsaicin receptors.

Cells transfected with expression plasmids (as described in Example 10) and thereby expressing the human capsaicin receptor are seeded and grown to 70-90% confluency in FALCON

black-walled, clear-bottomed 96-well plates (#3904, BECTON-DICKINSON, Franklin Lakes, NJ). The culture media are emptied from the 96 well plates and FLUO-3 AM calcium sensitive dye (Molecular Probes, Eugene, OR) is added to each well (dye 5 solution: 1 mg FLUO-3 AM, 440 uL DMSO and 440 ul 20% pluronic acid in DMSO, diluted 1:4, 50 ul diluted solution per well). Plates are covered with aluminum foil and incubated at 37 C for 1-2 hours in an environment containing 5% CO<sub>2</sub>. After the 10 incubation the dye is emptied from the plates, and the cells are washed once with Krebs-Ringer HEPES (KRH) buffer (25 mM HEPES, 5 mM KCl, 0.96 mM NaH<sub>2</sub>PO<sub>4</sub>, 1 mM MgSO<sub>4</sub>, 2 mM CaCl<sub>2</sub>, 5 mM glucose, 1 mM probenecid, pH 7.4), and resuspended in KRH buffer.

Agonist (e.g., olvanil, capsaicin, or RTX)-induced calcium 15 mobilization is monitored using either FLUOROSKAN ASCENT (Labsystems, Franklin, MA) or FLIPR (fluorometric imaging plate reader system, Molecular Devices, Sunnyvale, CA) instruments. Similarly, varying concentrations of the antagonists ruthenium red or capsazepine are added to cells concurrently with agonist 20 (e.g., 25-50 nM capsaicin). For agonist-induced calcium responses, data obtained between 30 and 60 seconds after agonist application are used to generate the EC<sub>50</sub> values. KALEIDAGRAPH software (Synergy Software, Reading, PA) was utilized to fit the data to the equation:

25  $y=a*(1/(1+(b/x)^c))$

to determine the EC<sub>50</sub> for the response. In this equation, y is the maximum fluorescence signal, x is the concentration of the agonist or antagonist, a is the E<sub>max</sub>, b corresponds to the EC<sub>50</sub> or IC<sub>50</sub> value, and finally, c is the Hill coefficient.

30 Assay for Determination of Capsaicin Receptor Antagonist Effects

In order to measure the ability of a test compound to antagonize (inhibit) the response of cells expressing capsaicin receptors to capsaicin or other vanilloid agonist, the EC<sub>50</sub> of capsaicin is first determined.

5 An additional 20 ul of KRH buffer and 1 ul DMSO is added to each well of cells, prepared as described above. 100 ul capsaicin in KRH buffer is automatically transferred by the FLIPR instrument to each well. An 8-point concentration response curve, with final capsaicin concentrations of 1 nM to 10 3 uM, is used to determine capsaicin EC<sub>50</sub>.

Test compounds are dissolved in DMSO, diluted in 20 ul KRH buffer so that the final concentration of test compounds in the assay well is between 1 uM and 5 uM, and added to cells prepared as described above. The 96 well plates containing 15 prepared cells and test compounds are incubated in the dark, at room temperature for 0.5 - 6 hours. It is important that the incubation not continue beyond 6 hours. Just prior to determining the fluorescence response, 100 ul capsaicin in KRH buffer at twice the EC<sub>50</sub> concentration determined from the 20 concentration response curve is automatically added by the FLIPR instrument to each well of the 96 well plate for a final sample volume of 200 ul and a final capsaicin concentration equal to the EC<sub>50</sub>. The final concentration of test compounds in the assay wells is between 1 uM and 5 uM. Typically cells exposed to one 25 EC<sub>50</sub> of capsaicin exhibit a fluorescence response of about 10,000 Relative Fluorescence Units. Antagonists of the capsaicin receptor decrease this response by about 20%, preferably by about 50%, and most preferably by at least 80% as compared to matched control. The concentration of antagonist 30 required to provide a 50% decrease is the EC<sub>50</sub> for the antagonist (also referred to as the IC<sub>50</sub>).

Equilibrium binding parameters may be determined as described in Example 10.

Assay for Determination of Capsaicin Receptor Agonist Effects

The ability of a compound to act as an agonist of the 5 capsaicin receptor may be determined by measuring the fluorescence response of cells expressing capsaicin receptors, using the methods described above, in the absence of capsaicin, RTX, or other known capsaicin receptor agonists. Compounds that cause cells to exhibit fluorescence above background are 10 capsaicin receptor agonists. Highly preferred compounds of the invention are antagonists that are essentially free of agonist activity as demonstrated by the absence of detectable agonist activity in such an assay at compound concentrations below 4 nM, more preferably at concentrations below 10 uM and most 15 preferably at concentrations less than or equal to 100 uM.

Example 12

NPY Y5 receptor binding assay

The following assay is a standard assay for NPY Y5 20 (neuropeptide Y receptor 5) receptor binding that may be used to determine the affinity of compounds for the NPY Y5 receptor. Expression of a recombinant human Y5 receptor in cultured cells and receptor binding assays using of membranes prepared from such cells has been described previously, e.g. in US patent no. 25 5,602,024 at columns 17-20. US patent no. 5,602,024 is hereby incorporated by reference for its teachings regarding a recombinant human Y5 receptor, expression of this receptor in cultured cells, and receptor binding assays using membranes prepared from such cells.

30

Cell Culture

Baculovirus-infected Sf9 cells expressing recombinant human NPY Y5 receptors are harvested at 48 hrs.

Membrane preparation

5 Sf9 cell pellets are resuspended in lysis buffer (20mM Tris-HCl, 5mM EDTA, 0.5 ug/ml leupeptin, 2 ug/ml Aprotinin, 200 uM PMSF, pH 7.4) and homogenized using a POLYTRON homogenizer (setting 3 for 25-30 seconds). The homogenate was centrifuged (536 x g/ 10 minutes/ 4°C) to pellet the nuclei. The

10 supernatant containing isolated membranes are decanted to a clean centrifuge tube, centrifuged (48,000 x g/ 30 minutes, 4°C) and resuspended in 30 ml homogenization buffer. This centrifugation and resuspension step is repeated twice. The final pellet is resuspended in ice cold Dulbecco's PBS

15 containing 5 mM EDTA and stored in aliquots at -80 °C until needed. The protein concentration of the resulting membrane preparation is measured using the Bradford Protein assay, as described in Example 3. By this measure, a 1-liter culture of cells typically yields 100-125 mg of total membrane protein.

20 Thawed Sf9 membranes are washed with PBS and resuspended by Dounce homogenization (tight pestle) in binding buffer (50 mM Tris-HCl, 5 mM KCl, 120 mM NaCl, 2 mM CaCl<sub>2</sub>, 0.1% BSA, pH 7.4).

For competition binding analysis, membranes (10-25 ug) in

25 150 ul binding buffer are added to polypropylene tubes or 96-well deepwell plates containing [<sup>125</sup>I]PYY (porcine, NEN, Boston, MA)/GTP. Final concentration of [<sup>125</sup>I]PYY is 30-35pM/assay well; final concentration of GTP is 100uM/well. Nonspecific binding is determined in the presence of 1 uM NPY (human,

30 American Peptide Co., Sunnyvale, CA) and accounts for less than 10% of total binding. Test compounds at a concentration of 1-

4uM in 2ul DMSO are added to the assay mixtures. Final assay volume is 250 ul. For competition analysis test compounds are added at concentrations ranging from  $10^{-12}$  to  $10^{-6}$  M. Typically 11 concentration points are collected per saturation binding 5 curve. Following a 2-hour incubation at room temperature, the assay reactions are terminated by rapid vacuum filtration. Samples are filtered over presoaked (in polyethyleneimine for 2 hours prior to use) GF/C WHATMAN filters and rinsed 2 times with 5 mls cold binding buffer without BSA. Remaining bound 10 radioactivity is quantified by gamma counting. Ki values may be determined by the method described in Example 10.

Preferred compounds of the invention exhibit 10-fold greater affinity for the capsaicin receptor than for the chimeric NPY Y5 receptor, more preferred compounds of the 15 invention also exhibit 100-fold greater affinity for the capsaicin receptor than for the chimeric NPY Y5 receptor, and still more preferred compounds of the invention also exhibit 1000-fold greater affinity for the capsaicin receptor than for the chimeric NPY Y5 receptor. Most highly preferred compounds 20 of the invention do not exhibit detectable binding at the NPY 5 receptor.

Example 13

Preparation of radiolabeled probe compounds of the invention

The compounds of the invention are prepared as 25 radiolabeled probes by carrying out their synthesis using precursors comprising at least one atom that is a radioisotope. The radioisotope is preferably selected from of at least one of carbon (preferably  $^{14}\text{C}$ ), hydrogen (preferably  $^3\text{H}$ ), sulfur (preferably  $^{35}\text{S}$ ), or iodine (preferably  $^{125}\text{I}$ ). Such radiolabeled 30 probes are conveniently synthesized by a radioisotope supplier specializing in custom synthesis of radiolabeled probe

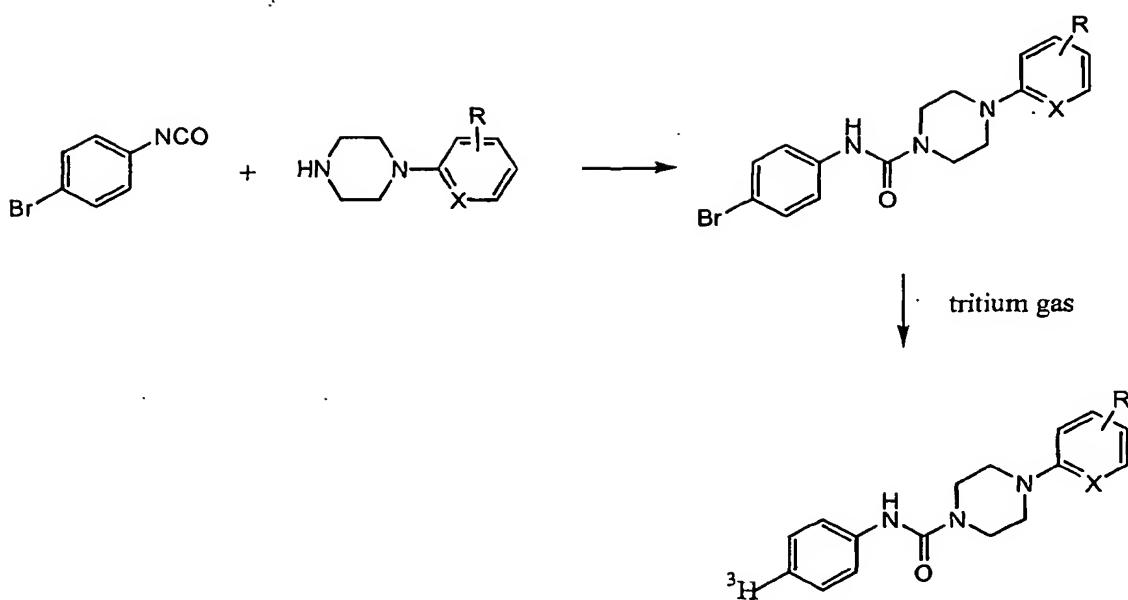
compounds. Such suppliers include Amersham Corporation, Arlington Heights, IL; Cambridge Isotope Laboratories, Inc. Andover, MA; SRI International, Menlo Park, CA; Wizard Laboratories, West Sacramento, CA; ChemSyn Laboratories, 5 Lexena, KS; American Radiolabeled Chemicals, Inc., St. Louis, MO; and Moravek Biochemicals Inc., Brea, CA.

Tritium labeled probe compounds are also conveniently prepared catalytically via platinum-catalyzed exchange in tritiated acetic acid, acid-catalyzed exchange in tritiated 10 trifluoroacetic acid, or heterogeneous-catalyzed exchange with tritium gas. Such preparations are also conveniently carried out as a custom radiolabeling by any of the suppliers listed in the preceding paragraph using the compound of the invention as substrate. In addition, certain precursors may be subjected to 15 tritium-halogen exchange with tritium gas, tritium gas reduction of unsaturated bonds, or reduction using sodium borotritide, as appropriate.

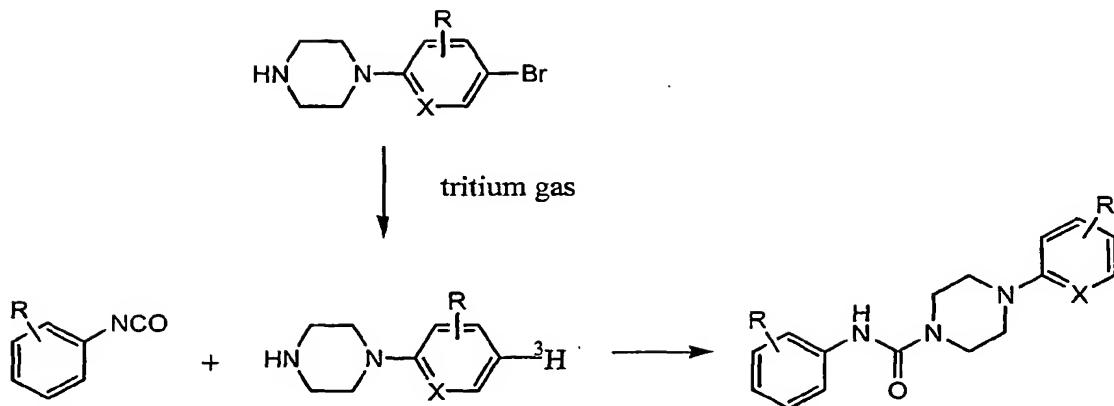
Examples 14a and 14b

20 Preparation of radiolabeled aryl piperazine Capsaicin receptor ligands

Example 14a



Scheme 3

example 14b

Scheme 4

5 Example 15Receptor autoradiography

Receptor autoradiography (receptor mapping) is carried out *in vitro* as described by Kuhar in sections 8.1.1 to 8.1.9 of

Current Protocols in Pharmacology (1998) John Wiley & Sons, New York, using radiolabeled compounds of the invention prepared as described in the preceding Example.

5    Example 16

Additional Aspects of Preferred Compounds of the Invention

The most preferred compounds of the invention are suitable for pharmaceutical use in treating human patients.

Accordingly, such preferred compounds are non-toxic. They do  
10 not exhibit single or multiple dose acute or long-term toxicity, mutagenicity (e.g., as determined in a bacterial reverse mutation assay such as an Ames test), teratogenicity, tumorogenicity, or the like, and rarely trigger adverse effects (side effects) when administered at therapeutically effective  
15 dosages.

Preferably, administration of such preferred compounds of the invention at certain doses (i.e., doses yielding therapeutically effective *in vivo* concentrations or preferably doses of 0.01, 0.05, 0.1, 0.5, 1, 5, 10, 40, or 50 mg/kg  
20 administered parenterally or preferably orally) does not result in prolongation of heart QT intervals (i.e., as determined by electrocardiography, e.g., in guinea pigs, minipigs or dogs). When administered daily for 5 or preferably ten days, such doses of such preferred compounds also do not  
25 cause liver enlargement resulting in an increase of liver to body weight ratio of more than 100%, preferably not more than 75% and more preferably not more than 50% over matched controls in laboratory rodents (e.g., mice or rats). In another aspect such doses of such preferred compounds also preferably do not  
30 cause liver enlargement resulting in an increase of liver to body weight ratio of more than 50%, preferably preferably not

more than 25%, and more preferably not more than 10% over matched untreated controls in dogs or other non-rodent mammals.

In yet another aspect such doses of such preferred compounds also preferably do not promote the release of liver enzymes (e.g., ALT, LDH, or AST) from hepatocytes *in vivo*. Preferably such doses do not elevate serum levels of such enzymes by more than 100%, preferably not by more than 75% and more preferably not by more than 50% over matched untreated controls *in vivo* in laboratory rodents. Similarly, concentrations (in culture media or other such solutions that are contacted and incubated with cells *in vitro*) equivalent to two, fold, preferably five-fold, and most preferably ten-fold the minimum *in vivo* therapeutic concentration do not cause release of any of such liver enzymes from hepatocytes *in vitro* into culture medium above baseline levels seen in media from untreated cells.

Because side effects are often due to undesirable receptor activation or antagonism, preferred compounds of the invention exert their receptor-modulatory effects with high selectivity. This means that they do not bind to certain other receptors (other than capsaicin receptors) with high affinity, but rather only bind to, activate, or inhibit the activity of such other receptors with affinity constants of greater than 100 nanomolar, preferably greater than 1 micromolar (uM), more preferably greater than 10 uM and most preferably greater than 100 uM. Such receptors preferably are selected from the group including ion channel receptors, including sodium ion channel receptors, neurotransmitter receptors such as alpha- and beta-adrenergic receptors, muscarinic receptors (particularly m1, m2, and m3 receptors), dopamine receptors, and metabotropic glutamate receptors; and also include histamine receptors and

cytokine receptors, e.g., interleukin receptors, particularly IL-8 receptors. The group of other receptors to which preferred compounds do not bind with high affinity also includes GABA<sub>A</sub> receptors, bioactive peptide receptors (including 5 NPY and VIP receptors), neurokinin receptors, bradykinin receptors (e.g., BK1 receptors and BK2 receptors), and hormone receptors (including androgen receptors, thyrotropin releasing hormone receptors and melanocyte-concentrating hormone receptors).

10

Example 16a

Sodium Ion Channel and Anti-Androgen Activity Criteria

Preferred compounds of the invention do not exhibit significant activity as sodium ion channel blockers, exhibiting 15 less than 15 percent inhibition, and more preferably less than 10 percent inhibition, of sodium channel specific ligand (e.g., batrachotoxin, tetrodotoxin, or saxitoxin) binding when present at a concentration of 4 uM or less.

Preferred compounds of the invention do not exhibit 20 significant androgen bioactivity, more preferably they do not exhibit significant androgen antagonist activity, e.g., *in vivo*, in a Hershberger assay, or *in vitro*, in an assay such as that described by Nellemann et al., *Toxicology* 2001, 163(1):29-38. Preferred compounds of the invention exhibit less than a 25 15% inhibition, more preferably less than a 10%, and most preferably less than 5% inhibition of androgen receptor activation in this *in vitro* assay when present at concentrations of 4 uM or less.

By significant activity is meant results varying from 30 control at the p<0.1 level or more preferably at the p<0.05

level of significance as measured using a standard parametric assay of statistical significance such as a student's T test.

Example 16b

5 Microsomal in vitro half-life

Compound half-life values ( $t_{1/2}$  values) may be determined via the following standard liver microsomal half-life assay. Pooled Human liver microsomes are obtained from XenoTech LLC, 3800 Cambridge St., Kansas City, Kansas 66103 (catalog # 10 H0610). Such liver microsomes may also be obtained, e.g., from In Vitro Technologies, Baltimore, MD 21227, or from Tissue Transformation Technologies, Edison, NJ 08837. Reactions are preformed as follows:

15 Reagents:

Phosphate buffer: 19 mL 0.1 M  $\text{NaH}_2\text{PO}_4$ , 81 mL 0.1 M  $\text{Na}_2\text{HPO}_4$ , adjusted to pH 7.4 with  $\text{H}_3\text{PO}_4$ .

CoFactor Mixture: 16.2 mg NADP, 45.4 mg Glucose-6-phosphate in 4 mL 100 mM  $\text{MgCl}_2$ .

20 Glucose-6-phosphate dehydrogenase: 214.3  $\mu\text{l}$  glucose-6-phosphate dehydrogenase suspension (Boehringer-Manheim catalog no. 0737224, distributed by Roche Molecular Biochemicals, Indianapolis, IN 46250) is diluted into 1285.7  $\mu\text{l}$  distilled water.

25 Starting Reaction Mixture: 3 mL CoFactor Mixture, 1.2 mL Glucose-6-phosphate dehydrogenase.

Reaction:

6 test reactions are prepared, each containing 25  $\mu\text{l}$  30 microsomes, 5  $\mu\text{l}$  of a 100  $\mu\text{M}$  solution of test compound, and 399  $\mu\text{l}$  0.1 M phosphate buffer. A seventh reaction is prepared as a

positive control containing 25  $\mu$ l microsomes, 399  $\mu$ l 0.1 M phosphate buffer, and 5  $\mu$ l of a 100  $\mu$ M solution of a compound with known metabolic properties (e.g. DIAZEPAM or CLOZEPINE).

Reactions are preincubated at 39°C for 10 minutes. 71  $\mu$ l

5 Starting Reaction Mixture is added to 5 of the 6 test reactions and to the positive control, 71  $\mu$ l 100 mM MgCl<sub>2</sub> is added to the sixth test reaction, which is used as a negative control. At each time point (0, 1, 3, 5, and 10 minutes) 75  $\mu$ l of each reaction mix is pipetted into a well of a 96-well deep-well 10 plate containing 75  $\mu$ l ice-cold acetonitrile. Samples are vortexed and centrifuged 10 minutes at 3500 rpm (Sorval T 6000D 15 centrifuge, H1000B rotor). 75  $\mu$ l of supernatant from each reaction is transferred to a well of a 96-well plate containing 150  $\mu$ l of a 0.5  $\mu$ M solution of a compound with a known LCMS profile (internal standard) per well. LCMS analysis of each sample is carried out and the amount of unmetabolized test compound is measured as AUC, compound concentration vs time is plotted, and the  $t_{1/2}$  value of the test compound is extrapolated.

20 Preferred compounds of the invention exhibit *in vitro*  $t_{1/2}$  values of greater than 10 minutes and less than 4 hours. Most preferred compounds of the invention exhibit *in vitro* half-life values of between 30 minutes and 1 hour in human liver 25 microsomes.

25

Example 16c

MDCK Toxicity Assay

Compounds causing acute cytotoxicity will produce a substantial decrease of ATP production by Madin Darby canine 30 kidney (MDCK) cells in the following assay. Preferred compounds of the invention will not.

MDCK cells, ATCC no. CCL-34 (American Type Culture Collection, Manassas, VA) are maintained in sterile conditions following the instructions in the ATCC production information sheet. The PACKARD, (Meriden, CT) ATP-LITE-M Luminescent ATP 5 detection kit, product no. 6016941, allows measurement ATP production in MDCK cells.

Prior to assay 1 ul of test compound or control sample is pipetted into PACKARD (Meriden, CT) clear bottom 96-well plates. Test compounds and control samples are diluted in DMSO 10 to give final concentration in the assay of 10 micromolar, 100 micromolar, or 200 micromolar. Control samples are drug or other compounds having known toxicity properties.

Confluent MDCK cells are trypsinized, harvested, and diluted to a concentration of  $0.1 \times 10^6$  cells/ ml with warm 15 (37°C) VITACELL Minimum Essential Medium Eagle (ATCC catalog # 30-2003). 100ul of cells in medium is pipetted into each of all but five wells of each 96-well plate. Warm medium without cells (100ul) is pipetted in the remaining five wells of each plate to provide standard curve control wells. These wells, to 20 which no cells are added, are used to determine the standard curve. The plates are then incubated at 37°C under 95% O<sub>2</sub>, 5% CO<sub>2</sub> for 2 hours with constant shaking. After incubation, 50 ul of mammalian cell lysis solution is added per well, the wells are covered with PACKARD TOPSEAL stickers, and plates are 25 shaken at approximately 700 rpm on a suitable shaker for 2 minutes.

During the incubation, PACKARD ATP LITE-M reagents are allowed to equilibrate to room temperature. Once equilibrated the lyophilized substrate solution is reconstituted in 5.5 mls 30 of substrate buffer solution (from kit). Lyophilized ATP standard solution is reconstituted in deionized water to give a

10 mM stock. For the five control wells, 10  $\mu$ l of serially diluted PACKARD standard is added to each of the five standard curve control wells to yield a final concentration in each subsequent well of 200 nM, 100 nM, 50 nM, 25 nM, and 12.5 nM.

5       PACKARD substrate solution (50  $\mu$ l) is added to all wells. Wells are covered with PACKARD TOPSEAL stickers, and plates are shaken at approximately 700 rpm on a suitable shaker for 2 minutes. A white PACKARD sticker is attached to the bottom of each plate and samples are dark adapted by wrapping plates in 10 foil and placing in the dark for 10 minutes. Luminescence is then measured at 22°C using a luminescence counter, e.g. PACKARD TOPCOUNT Microplate Scintillation and Luminescence Counter or TECAN SPECTRAFLUOR PLUS.

Luminescence values at each drug concentration are 15 compared to the values computed from the standard curve for that concentration. Preferred test compounds exhibit luminescence values 80% or more of the standard, or preferably 90 % or more of the standard, when a 10 micromolar ( $\mu$ M) concentration of the test compound is used. When a 100  $\mu$ M concentration of the test compound is used, preferred test 20 compounds exhibit luminescence values 50% or more of the standard, or more preferably 80% or more of the standard. Luminescence values less than 50% of the standard indicate a substantial decrease of ATP production.

25       Example 18

Animal Models for Determining Pain Relief and Sedation

The following experimental protocols can be used to determine the degree of pain relief and sedation provided by 30 compounds of the invention, e.g., in comparison to pain relief and sedation provided by morphine or pain relief by ibuprofen.

Example 18aCFA arthritis model

Male SD rats are injected with 200 ml of CFA (0.1mg heat  
5 killed and dried *M. tuberculosis*/ml) in the hind paw (100 ml on  
the dorsal and 100 ml on the plantar surface of the paw)  
essentially as described by Bertorelli R, Corradini L, Rafiq K,  
Tupper J, Calo G, Ongini E., *Br J Pharmacol.* 1999 128 (6):1252-8  
and by Stein C, Millan MJ, Herz A. *Pharmacol Biochem Behav.*  
10 1988 31 (2):455-51.

Rats are tested for thermal (as described by Hargreaves K,  
Dubner R, Brown F, Flores C, Joris J. *Pain.* 1988 32 (1):77-88)  
and mechanical (as described by Tal M, Eliav E. *Pain.* 1996  
15 Mar; 64 (3):511-8) sensitivities on days 5, 6, and 7. Baseline  
data should be obtained for each animal prior to CFA injection.

On day 7, animals are treated orally with a compound of  
the invention, morphine or vehicle (2% vitamin E-TPGS) 1 hour  
prior to testing. Note: an oral dose of 5mg/kg morphine has  
sedative effects.

20 Results are conveniently expressed as % of Maximum  
Potential Efficacy (MPE). 0% MPE is defined as analgesic effect  
of vehicle, 100% MPE is defined as an animal's return to  
baseline level of thermal or mechanical sensitivity.

25 Example 18b

Mechanical Allodynia

This assay determines the effectiveness of compounds of  
Formulae I-IX and Formulae A-F in relieving at least one of the  
symptoms in an *in vivo* model of pain produced by spinal nerve  
30 ligation, namely mechanical allodynia.

Tactile allodynia is induced in rats using the procedures

described by Bennet and Xie, Pain 1988, 33:87-107. Rats are anesthetized, e.g., with an intraperitoneal dose of pentobarbital sodium (65 mg/kg) with additional doses of anesthetic given as needed. The lateral aspect of each rat's 5 hind limb is shaved and disinfected. Using aseptic technique, an incision is made on the lateral aspect of the hind limb at the mid-thigh level. The biceps femoris is bluntly dissected to expose the sciatic nerve. On one hind limb of each rat, four loosely tied ligatures are made around the sciatic nerve 10 approximately 1-2 millimeters apart. On the other side of each rat, an identical dissection is performed except that the sciatic nerve is not ligated. The muscle is closed with a continuous suture pattern, and the skin is closed with wound clips or sutures.

15        Mechanical sensitivity is assessed using a procedure described by Chaplan et al. J. Neurosci. Methods 1994, 53:55-63. A series of Von Frey filaments of varying rigidity strength (typically eight filaments in the series) are applied to the plantar surface of the hind paw ipsilateral to the ligations 20 with just enough force to bend the filament. The filaments are held in this position for no more than three seconds or until a positive allodynic response is displayed by the rat. A positive allodynic response consists of lifting the affected paw followed immediately by licking or shaking of the paw. The 25 order and frequency with which the individual filaments are applied are determined by using Dixon up-down method. Testing is initiated with the middle hair of the series with subsequent filaments being applied in consecutive fashion, ascending or descending, depending on whether a negative or positive 30 response, respectively, is obtained with the initial filament.

Certain preferred compounds of Formulae I-IX and Formulae

A-F are effective in reversing mechanical allodynia-like symptoms (i.e., rats treated with effective amounts of such compounds will require stimulation with a Von Frey filament of higher rigidity strength to provoke a positive allodynic response as compared to control untreated or vehicle treated rats) when tested by this method.

Example 18c

Cold Allodynia

10 This assay determines the effectiveness of compounds in relieving one of the symptoms of neuropathic pain produced by unilateral mononeuropathy, namely cold allodynia.

Unilateral mononeuropathy is produced in rats using the Chronic Constriction Injury model performed essentially as described by Bennet and Xie, Pain 1988, 33:87-107. Rats are anesthetized. The lateral aspect of each rat's hind limb is shaved and disinfected. Using aseptic technique, an incision is made on the lateral aspect of the hind limb at the mid-thigh level. The biceps femoris is bluntly dissected to expose the sciatic nerve. On one hind limb of each rat, four loosely tied ligatures are made around the sciatic nerve approximately 1-2 millimeters apart. On the other side of each rat, an identical dissection is performed except that the sciatic nerve is not ligated. The muscle is closed with a continuous suture pattern, and the skin is closed with wound clips or sutures.

Rats demonstrating unilateral mononeuropathy are assessed for acute and chronic cold allodynia sensitivity. Each rat is placed individually into a chamber with a metal plate about 6 cm from the bottom. This chamber is filled with ice water to a depth of about 2.5 cm above the metal plate, with the temperature of the bath maintained at about zero to four

degrees C throughout the experiment. A timer is started, and the rat's response latency is measured to the nearest tenth of a second. A "response" is defined as a rapid withdrawal of the ligated hindpaw completely out of the water while the animal is 5 stationary and not pivoting. An exaggerated limp while the animal is walking is not scored as a response. Maximum immersion time is 20 seconds with a 20-minute interval between trials. The screening criteria are 1) the average of two trials is less than or equal to 13 seconds, and 2) there is 10 consistency across the two trial scores. Animals are screened for hypersensitivity to cold on post-surgery days 4 through 10, and selected for inclusion in drug-response studies based on the criteria described above. The pre-dose screening values are used as the animal's baseline cold allodynia scores. For acute 15 studies, the animals are tested for cold allodynia at 1, 3, and sometimes 5 hours post-dose.

Although this acute cold allodynia assay is generally less preferred for demonstrating efficacy of compounds of the invention, when tested in this assay, certain preferred 20 compounds of Formulae I-IX and Formulae A-F demonstrate anti-allodynic effects (increases in response latency) at doses of less than 50 mg/kg.

Example 18d

25 Mechanical Hyperalgesia

This assay determines the effectiveness of compounds in relieving one of the symptoms of neuropathic pain produced by unilateral mononeuropathy, namely mechanical hyperalgesia.

A chronic constriction injury is produced by loosely 30 ligating the right common sciatic nerve as described by Bennet and Xie, Pain 1988; 33:87-107. The left common sciatic nerve is

visualized, but not manipulated to produce sham conditions.

The rats having a chronic constriction injury are assessed for mechanical hyperalgesia to a pin-prick stimulus as described by Koch et al. Analgesia 1996, 2(3), 157-164. Rats 5 are placed in individual compartments of a cage with a warmed, perforated metal floor. Hindpaw withdrawal duration is measured after a mild pinprick to the plantar surface of the ligated and sham hindpaws.

Preferred compounds of the invention produce a reduction 10 of mechanical hyperalgesia (i.e., a reduction in the duration of hindpaw withdrawal) elicited by a pin-prick stimulus in rats with a chronic constriction injury at doses of 50 mg/kg or less when tested by this method.

15 Example 18e

Thermal Hyperalgesia

This assay determines the effectiveness of compounds in relieving one of the symptoms of neuropathic pain produced by unilateral mononeuropathy, namely thermal hyperalgesia.

20 Rats having had surgery as described in Example 18d are assessed for thermal hyperalgesia sensitivity at least 10 days post-surgery. The rats are placed beneath inverted cages upon an elevated glass platform and a radiant heat source beneath the glass is aimed at the plantar hindpaw.

25 The duration of time before the hindpaw is withdrawn from the floor is measured to the nearest tenth of a second. The cutoff time for the heat stimulus is 20 seconds, and the light is calibrated such that this stimulus duration does not burn or blister the skin. Preferably about four latency measurements 30 are taken for each hindpaw in each test session, alternating left and right hindpaws, with 5-minute intervals between tests.

The times to withdrawal of each side are averaged and a difference score is obtained.

Preferred compounds of the invention produce an increase in the average time to withdrawal after oral administration of 5 50 mg/kg or less in this model.

Example 18f

Sedation

10 Sedation may be determined using the method described by Fitzgerald et al., *Toxicology* 1988, 49(2-3) 433-9. Preferred compounds of the invention do not produce reproducible or significant sedation at intravenous doses of less than 25 mg/kg (preferably less than 10 mg/kg) or at oral doses of less than 140 mg/kg (preferably less than 50 mg/kg).

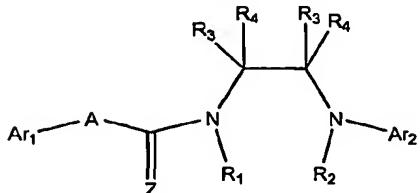
15

Claims

What is claimed is:

1. A compound of the formula:

5



or a pharmaceutically acceptable salt thereof,  
wherein:

10 A is absent or is selected from the group consisting of O, S, NR<sub>A</sub>, CR<sub>B</sub>R<sub>B'</sub>, NR<sub>A</sub>CR<sub>B</sub>R<sub>B'</sub>, CR<sub>B</sub>R<sub>B'</sub>NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub>, R<sub>B</sub>, and R<sub>B'</sub> are independently selected at each occurrence from hydrogen or alkyl;

Z is oxygen or sulfur;

15 R<sub>1</sub> and R<sub>2</sub> independently represent hydrogen or alkyl;

R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted alkyl; optionally substituted alkenyl; optionally substituted

20 alkynyl; optionally substituted alkoxy; optionally substituted mono or dialkylamino; optionally substituted alkylthio; optionally substituted alkyl ketone; optionally substituted alkylester; optionally substituted alkylsulfinyl; optionally substituted alkylsulfonyl;

25 optionally substituted mono- or di-alkylcarboxamide; optionally substituted -S(O)<sub>n</sub>NHalkyl; optionally substituted -S(O)<sub>n</sub>N(alkyl)(alkyl); optionally substituted -NHC(=O)alkyl; optionally substituted -

NC(=O)(alkyl)(alkyl); optionally substituted -NHS(O)<sub>n</sub>alkyl; optionally substituted -NS(O)<sub>n</sub>(alkyl)(alkyl); optionally substituted saturated or partially unsaturated heterocycloalkyl of from 5 to 8 atoms, which saturated or partially unsaturated heterocycloalkyl contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; or optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S;

5 or any two .

R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an optionally substituted aryl ring; a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is optionally substituted; or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is optionally substituted and contains 1, 2, or 3 heteroatoms selected from N, O, and S; and

10 Ar<sub>1</sub> and Ar<sub>2</sub> are the same or different and independently represent optionally substituted cycloalkyl; an optionally substituted heterocycloalkyl ring of from 5 to 8 atoms, which heterocycloalkyl ring contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; or optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S, and

15 20 25 30

Ar<sub>1</sub> and Ar<sub>2</sub> are the same or different and independently represent optionally substituted cycloalkyl; an optionally substituted heterocycloalkyl ring of from 5 to 8 atoms, which heterocycloalkyl ring contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; or optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S, and

n is independently chosen at each occurrence from 0, 1, and 2.

2. A compound or salt according to Claim 1, wherein:

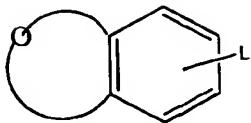
R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, haloalkyl, haloalkoxy, hydroxy, amino, alkyl substituted with 0-2 R<sub>6</sub>, alkenyl substituted with 0-2 R<sub>6</sub>; alkynyl substituted with 0-2 R<sub>6</sub>; alkoxy substituted with 0-2 R<sub>6</sub>, -NH(alkyl) substituted with 0-2 R<sub>6</sub>, -N(alkyl)(alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

10 or any two

R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an aryl ring substituted with 0-3 R<sub>6</sub>, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is substituted with 0-2 R<sub>6</sub>, or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is substituted with 0-2 R<sub>6</sub> and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

15 Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl, piperidinyl, piperazinyl, phenyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, 20 indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl, each of which is optionally mono-, di-, or trisubstituted with R<sub>5</sub>; or

25 Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and represent a bicyclic oxygen-containing group of the formula:



optionally mono-, di-, or trisubstituted with  $R_5$ , where L represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the 5 bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

$R_5$  is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, haloalkyl, 10 haloalkoxy, hydroxy, amino, alkyl substituted with 0-2  $R_6$ , alkenyl substituted with 0-2  $R_6$ , alkynyl substituted with 0-2  $R_6$ , alkoxy substituted with 0-2  $R_6$ ,  $-NH(alkyl)$  substituted with 0-2  $R_6$ ,  $-N(alkyl)(alkyl)$  where each alkyl is independently substituted with 0-2  $R_6$ ,  $-XR_7$ , and Y;

$R_6$  is independently selected at each occurrence from the group 15 consisting of halogen, hydroxy, cyano, alkyl, alkoxy,  $-NH(alkyl)$ ,  $-N(alkyl)(alkyl)$ ,  $-S(O)_n(alkyl)$ , haloalkyl, haloalkoxy,  $CO(alkyl)$ ,  $CON(alkyl_1)(alkyl_2)$  where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a 20 heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and Y;

X is independently selected at each occurrence from the group 25 consisting of  $-CH_2-$ ,  $-CHR_8-$ ,  $-O-$ ,  $-S(O)_n-$ ,  $-NH-$ ,  $-NR_8-$ ,  $-C(=O)-$ ,  $-C(=O)O-$ ,  $-C(=O)NH-$ ,  $-C(=O)NR_8-$ ,  $-S(O)_nNH-$ ,  $-S(O)_nNR_8-$ ,  $NHC(=O)-$ ,  $-NR_8C(=O)-$ ,  $-NHS(O)_n-$ , and  $-NR_8S(O)_n-$ ;

$R_7$  and  $R_8$  are independently selected at each occurrence from 30 hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and

cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(alkyl), -N(alkyl)C(O)(alkyl), -NHS(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>NH(alkyl), -S(O)<sub>n</sub>N(alkyl<sub>3</sub>)(alkyl<sub>4</sub>) where alkyl<sub>3</sub> and alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

15 Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, 20 alkyl, alkoxy, haloalkyl, haloalkoxy, mono- or dialkylamino, and alkylthio;

wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and

25 n is independently chosen at each occurrence from 0, 1, and 2.

3. A compound or salt according to Claim 1, wherein: R<sub>A</sub>, R<sub>B</sub>, and R<sub>B'</sub> are independently selected at each occurrence from hydrogen and C<sub>1-6</sub>alkyl;

30 R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro,

halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>; C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>; C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>,

5 R<sub>6</sub>,  
-N(C<sub>1-6</sub>alkyl) (C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>,  
-XR<sub>7</sub>, and Y;

or any two

10 R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an aryl ring substituted with 0-3 R<sub>6</sub>, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is substituted with 0-2 R<sub>6</sub>, or a saturated, partially unsaturated, or aromatic

15 heterocyclic ring of from 5 to 8 members, which heterocyclic ring is substituted with 0-2 R<sub>6</sub> and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

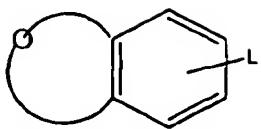
Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl,

20 piperidinyl, piperazinyl, phenyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl,

25 benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl, each of which is optionally mono-, di-, or trisubstituted with R<sub>5</sub>; or

Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and represent a

30 bicyclic oxygen-containing group of the formula:



optionally mono-, di-, or trisubstituted with  $R_5$ , where  $L$  represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

$R_5$  is independently selected at each occurrence from the group consisting of halogen, cyano, nitro,  $\text{halo}(C_{1-6})\text{alkyl}$ ,  $\text{halo}(C_{1-6})\text{alkoxy}$ , hydroxy, amino,  $C_{1-6}\text{alkyl}$  substituted with 0-2  $R_6$ ,  $C_{2-6}\text{alkenyl}$  substituted with 0-2  $R_6$ ,  $C_{2-6}\text{alkynyl}$  substituted with 0-2  $R_6$ ,  $C_{1-6}\text{alkoxy}$  substituted with 0-2  $R_6$ ,  $-\text{NH}(C_{1-6}\text{alkyl})$  substituted with 0-2  $R_6$ ,  $-\text{N}(C_{1-6}\text{alkyl})(C_{1-6}\text{alkyl})$  where each  $C_{1-6}\text{alkyl}$  is independently substituted with 0-2  $R_6$ ,  $-\text{XR}_7$ , and  $Y$ ;

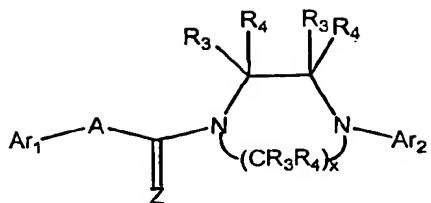
$R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano,  $C_{1-4}\text{alkyl}$ ,  $C_{1-4}\text{alkoxy}$ ,  $-\text{NH}(C_{1-4}\text{alkyl})$ ,  $-\text{N}(C_{1-4}\text{alkyl})(C_{1-4}\text{alkyl})$ ,  $-\text{S}(\text{O})_n(C_{1-4}\text{alkyl})$ ,  $\text{halo}(C_{1-4})\text{alkyl}$ ,  $\text{halo}(C_{1-4})\text{alkoxy}$ ,  $\text{CO}(C_{1-4}\text{alkyl})$ ,  $\text{CONH}(C_{1-4}\text{alkyl})$ ,  $\text{CON}(C_{1-4}\text{alkyl}_1)(C_{1-4}\text{alkyl}_2)$  where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-\text{XR}_7$ , and  $Y$ ;

$X$  is independently selected at each occurrence from the group consisting of  $-\text{CH}_2-$ ,  $-\text{CHR}_8-$ ,  $-\text{O}-$ ,  $-\text{S}(\text{O})_n-$ ,  $-\text{NH}-$ ,  $-\text{NR}_8-$ ,  $-\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{O}-$ ,  $-\text{C}(=\text{O})\text{NH}-$ ,  $-\text{C}(=\text{O})\text{NR}_8-$ ,  $-\text{S}(\text{O})_n\text{NH}-$ ,  $-\text{S}(\text{O})_n\text{NR}_8-$ ,  $\text{NHC}(=\text{O})-$ ,  $-\text{NR}_8\text{C}(=\text{O})-$ ,  $-\text{NHS}(\text{O})_n-$ , and  $-\text{NR}_8\text{S}(\text{O})_n-$ ;

$R_7$  and  $R_8$  are independently selected at each occurrence from

hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or 5 one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(C<sub>1-4</sub>alkyl), -NH(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl), -NHC(O)(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)C(O)(C<sub>1-4</sub>alkyl), -NHS(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>NH(C<sub>1-4</sub>alkyl), 10 -S(O)<sub>n</sub>N(C<sub>1-4</sub>alkyl<sub>3</sub>)(C<sub>1-4</sub>alkyl<sub>4</sub>) where C<sub>1-4</sub>alkyl<sub>3</sub> and C<sub>1-4</sub>alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 15 heteroatoms selected from N, O, and S, and Y'; Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, 20 C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, mono- or di(C<sub>1-4</sub>)alkylamino, and C<sub>1-4</sub>alkylthio; wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected 25 from N, O, and S; and n is independently chosen at each occurrence from 0, 1, and 2.

4. A compound of the formula:



or a pharmaceutically acceptable salt thereof, wherein:

A is absent or is selected from the group consisting of O, S,

Z is oxygen or sulfur;

10  $R_3$  and  $R_4$  are independently selected at each occurrence from the group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted alkyl; optionally substituted alkenyl; optionally substituted alkynyl; optionally substituted alkoxy; optionally substituted mono or dialkylamino; optionally substituted alkylthio; optionally substituted alkyl ketone; optionally substituted alkylester; optionally substituted alkylsulfinyl; optionally substituted alkylsulfonyl; optionally substituted mono- or di-alkylcarboxamide; optionally substituted  $-S(O)_nNHalkyl$ ; optionally substituted  $-S(O)_nN(alkyl)(alkyl)$ ; optionally substituted  $-NHC(=O)alkyl$ ; optionally substituted  $-NC(=O)(alkyl)(alkyl)$ ; optionally substituted  $-NHS(O)_nalkyl$ ; optionally substituted  $-NS(O)_n(alkyl)(alkyl)$ ; optionally substituted saturated or partially unsaturated heterocycloalkyl of from 5 to 8 atoms, which saturated or partially unsaturated heterocycloalkyl contains 1, 2, or 3 heteroatoms selected

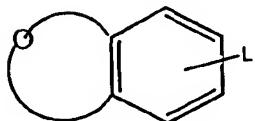
from N, O, and S; optionally substituted aryl having from 1 to 3 rings; and optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S;

5 or any two

R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form 10 an optionally substituted aryl ring, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is optionally substituted, or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is optionally substituted and contains 15 1, 2, or 3 heteroatoms selected from N, O, and S;

Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and are selected from 20 the group consisting of cyclohexyl, cyclopentyl, piperidinyl, piperazinyl, phenyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, 25 benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxaliny, each of which is optionally mono-, di-, or trisubstituted with R<sub>5</sub>; or

Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and represent a bicyclic oxygen-containing group of the formula:



optionally mono-, di-, or trisubstituted with  $R_5$ , where L represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

5  $R_5$  is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ,  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ ,  $-NH(C_{1-6}$ alkyl) substituted with 0-2  $R_6$ ,  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl) where each  $C_{1-6}$ alkyl is independently substituted with 0-2  $R_6$ ,  $-XR_7$ , and  $Y$ ;

10  $R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy,  $-NH(C_{1-4}$ alkyl),  $-N(C_{1-4}$ alkyl)( $C_{1-4}$ alkyl),  $-S(O)_n(C_{1-4}$ alkyl), halo( $C_{1-4}$ )alkyl, halo( $C_{1-4}$ )alkoxy,  $CO(C_{1-4}$ alkyl),  $CONH(C_{1-4}$ alkyl),  $CON(C_{1-4}$ alkyl<sub>1</sub>)( $C_{1-4}$ alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and  $Y$ ;

15  $X$  is independently selected at each occurrence from the group consisting of  $-CH_2-$ ,  $-CHR_8-$ ,  $-O-$ ,  $-S(O)_n-$ ,  $-NH-$ ,  $-NR_8-$ ,  $-C(=O)-$ ,  $-C(=O)O-$ ,  $-C(=O)NH-$ ,  $-C(=O)NR_8-$ ,  $-S(O)_nNH-$ ,  $-S(O)_nNR_8-$ ,  $NHC(=O)-$ ,  $-NR_8C(=O)-$ ,  $-NHS(O)_n-$ , and  $-NR_8S(O)_n-$ ;

20  $R_7$  and  $R_8$  are independently selected at each occurrence from hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or

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one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(alkyl), -N(alkyl)C(O)(alkyl), -NHS(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>NH(alkyl), -S(O)<sub>n</sub>N(alkyl<sub>3</sub>)(alkyl<sub>4</sub>) where alkyl<sub>3</sub> and alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';  
5 Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, alkyl, alkoxy, haloalkyl, haloalkoxy, mono- or 10 dialkylamino, and alkylthio;  
15 wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S;  
20 n is independently chosen at each occurrence from 0, 1, and 2; and  
x is 1 or 3.

25 5. A compound or salt according to Claim 4, wherein:  
R<sub>A</sub>, R<sub>B</sub>, and R<sub>B'</sub> are independently selected at each occurrence from hydrogen or C<sub>1-6</sub>alkyl;  
R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, 30 halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2

$R_6$ ;  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ;  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ ,  $-NH(C_{1-6}$ alkyl) substituted with 0-2  $R_6$ ,

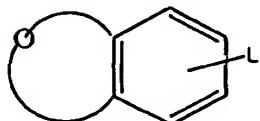
5 -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is  
 independently substituted with 0-2 R<sub>6</sub>,  
 -XR<sub>7</sub>, and Y;

or any two

10        R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an aryl ring substituted with 0-3 R<sub>6</sub>, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is substituted with 0-2 R<sub>6</sub>, or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is substituted with 0-2 R<sub>6</sub> and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl, piperidinyl, piperazinyl, phenyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl, each of which is optionally mono-, di-, or trisubstituted with R<sub>5</sub>; or

$\text{Ar}_1$  and  $\text{Ar}_2$  may be the same or different and represent a bicyclic oxygen-containing group of the formula:



optionally mono-, di-, or trisubstituted with  $R_5$ , where L represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

5  $R_5$  is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ,  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ ,  $-NH(C_{1-6}$ alkyl) substituted with 0-2  $R_6$ ,  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl) where each  $C_{1-6}$ alkyl is independently substituted with 0-2  $R_6$ ,  $-XR_7$ , and Y;

10  $R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy,  $-NH(C_{1-4}$ alkyl),  $-N(C_{1-4}$ alkyl)( $C_{1-4}$ alkyl),  $-S(O)_n(C_{1-4}$ alkyl), halo( $C_{1-4}$ )alkyl, halo( $C_{1-4}$ )alkoxy,  $CO(C_{1-4}$ alkyl),  $CON(C_{1-4}$ alkyl<sub>1</sub>)( $C_{1-4}$ alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of 20 from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and Y;

15  $X$  is independently selected at each occurrence from the group consisting of  $-CH_2-$ ,  $-CHR_8-$ ,  $-O-$ ,  $-S(O)_n-$ ,  $-NH-$ ,  $-NR_8-$ ,  $-C(=O)-$ ,  $-C(=O)O-$ ,  $-C(=O)NH-$ ,  $-C(=O)NR_8-$ ,  $-S(O)_nNH-$ ,  $25 -S(O)_nNR_8-$ ,  $NHC(=O)-$ ,  $-NR_8C(=O)-$ ,  $-NHS(O)_n-$ , and  $-NR_8S(O)_n-$ ;

20  $R_7$  and  $R_8$  are independently selected at each occurrence from hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and 30 cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or

one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)C(O)(C<sub>1-4</sub>alkyl), -NHS(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>N(C<sub>1-4</sub>alkyl<sub>3</sub>)(C<sub>1-4</sub>alkyl<sub>4</sub>) where C<sub>1-4</sub>alkyl<sub>3</sub> and C<sub>1-4</sub>alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, mono- or di(C<sub>1-4</sub>)alkylamino, and C<sub>1-4</sub>alkylthio;

wherein said 3- to 8-membered heterocyclic groups

contain one or more heteroatom(s) independently selected from N, O, and S;

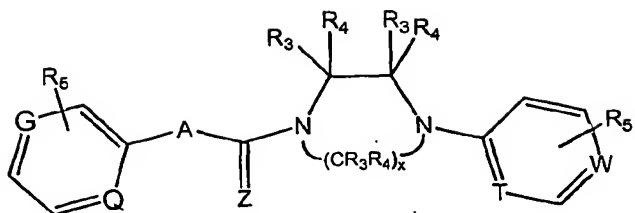
n is independently chosen at each occurrence from 0, 1, and 2;

and

x is 1 or 3.

6. A compound or salt according to Claim 4, wherein Z is oxygen.

7. A compound or salt according to Claim 4 of the formula:



or a pharmaceutically acceptable salt thereof, wherein:

G, Q, T, and W are the same or different and represent N, CH,

5 or CR<sub>5</sub>;

R<sub>A</sub>, R<sub>B</sub>, and R<sub>B'</sub> are independently selected at each occurrence from hydrogen or C<sub>1-6</sub>alkyl;

Z is oxygen or sulfur;

10 R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted alkyl; optionally substituted alkenyl; optionally substituted alkynyl; optionally substituted alkoxy; optionally substituted mono or dialkylamino; optionally substituted alkylthio; optionally substituted alkyl ketone; optionally substituted alkylester; optionally substituted alkylsulfinyl; optionally substituted alkylsulfonyl; optionally substituted mono- or di-alkylcarboxamide; optionally substituted -S(O)<sub>n</sub>NHalkyl; optionally substituted -S(O)<sub>n</sub>N(alkyl)(alkyl); optionally substituted -NHC(=O)alkyl; optionally substituted -NC(=O)(alkyl)(alkyl); optionally substituted -NHS(O)<sub>n</sub>alkyl; optionally substituted -NS(O)<sub>n</sub>(alkyl)(alkyl); optionally substituted saturated or partially unsaturated heterocycloalkyl of from 5 to 8 atoms, which saturated or partially unsaturated heterocycloalkyl contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; and optionally

substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S;

5 or any two

R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an optionally substituted aryl ring; a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is optionally substituted; 10 or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is optionally substituted and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

R<sub>5</sub> represents 0 to 3 substituents on each of the aryl rings on 15 which it occurs and is independently chosen at each occurrence from the group consisting of halogen, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy 20 substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

R<sub>6</sub> is independently selected at each occurrence from the group 25 consisting of halogen, hydroxy, cyano, alkyl, alkoxy, -NH(alkyl), -N(alkyl)(alkyl), -S(O)<sub>n</sub>(alkyl), haloalkyl, haloalkoxy, CO(alkyl), CONH(alkyl), CON(alkyl<sub>1</sub>)(alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and 30 containing 1, 2, or 3 heteroatoms selected from N, O, and S, -XR<sub>7</sub>, and Y;

X is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>8</sub>-, -C(=O)-, -C(=O)O-, -C(=O)NH-, -C(=O)NR<sub>8</sub>-, -S(O)<sub>n</sub>NH-, -S(O)<sub>n</sub>NR<sub>8</sub>-, NHC(=O)-, -NR<sub>8</sub>C(=O)-, -NHS(O)<sub>n</sub>-, and -NR<sub>8</sub>S(O)<sub>n</sub>;

5 R<sub>7</sub> and R<sub>8</sub> are independently selected at each occurrence from hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or

10 one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(alkyl),

15 -N(alkyl)C(O)(alkyl), -NHS(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>NH(alkyl), -S(O)<sub>n</sub>N(alkyl<sub>3</sub>)(alkyl<sub>4</sub>) where alkyl<sub>3</sub> and alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

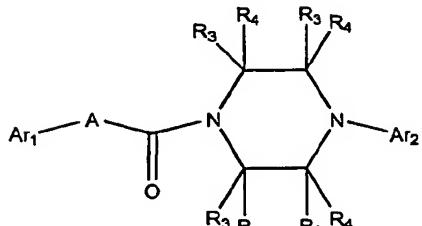
20 Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, alkyl, alkoxy, haloalkyl, haloalkoxy, mono- or dialkylamino, and alkylthio;

25 wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S;

30 n is independently chosen at each occurrence from 0, 1, and 2; and

x is 1 or 3.

8. A compound of the formula:



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or a pharmaceutically acceptable salt thereof, wherein:

A is absent or is selected from the group consisting of O, S, NR<sub>A</sub>, CR<sub>B</sub>R<sub>B</sub>', NR<sub>A</sub>CR<sub>B</sub>R<sub>B</sub>', CR<sub>B</sub>R<sub>B</sub>'NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub>, R<sub>B</sub>, and R<sub>B</sub>' are independently selected at each occurrence from hydrogen or alkyl;

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R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted alkyl; optionally substituted alkenyl; optionally substituted alkynyl; optionally substituted alkoxy; optionally substituted mono or dialkylamino; optionally substituted alkylthio; optionally substituted alkyl ketone; optionally substituted alkylester; optionally substituted alkylsulfinyl; optionally substituted alkylsulfonyl; optionally substituted mono- or di-alkylcarboxamide; optionally substituted -S(O)<sub>n</sub>NHalkyl; optionally substituted -S(O)<sub>n</sub>N(alkyl)(alkyl); optionally substituted -NHC(=O)alkyl; optionally substituted -NC(=O)(alkyl)(alkyl); optionally substituted -NHS(O)<sub>n</sub>alkyl; optionally substituted -NS(O)<sub>n</sub>(alkyl)(alkyl); optionally substituted saturated or partially unsaturated heterocycloalkyl of from 5 to 8

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atoms, which saturated or partially unsaturated heterocycloalkyl contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; and optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S;

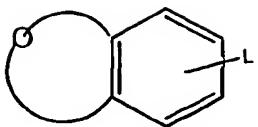
5 or any two

10  $R_3$  and  $R_4$  not attached to the same carbon may be joined to form an optionally substituted aryl ring; a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is optionally substituted; or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is optionally substituted and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

15  $Ar_1$  and  $Ar_2$  may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl, piperidinyl, piperazinyl, pyrrolyl, furanyl, thienyl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl, pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, 20 benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl; wherein  $Ar_1$  is optionally mono-, di-, or trisubstituted with  $R_5$ , and  $Ar_2$  is optionally mono-, di-, or trisubstituted with  $R_9$ ; or

25  $Ar_1$  and  $Ar_2$  may be the same or different and represent a bicyclic oxygen-containing group of the formula:

30



optionally mono-, di-, or trisubstituted with  $R_5$ , where  $L$  represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

5  $R_5$  is independently selected at each occurrence from the group consisting of cyano, nitro, haloalkyl, haloalkoxy, hydroxy, amino, alkyl substituted with 0-2  $R_6$ , alkenyl substituted with 0-2  $R_6$ , alkynyl substituted with 0-2  $R_6$ , alkoxy substituted with 0-2  $R_6$ ,  $-NH(alkyl)$  substituted with 0-2  $R_6$ ,  $-N(alkyl)(alkyl)$  where each alkyl is independently substituted with 0-2  $R_6$ ,  $-XR_7$ , and  $Y$ ;

10  $R_9$  is independently selected at each occurrence from the group consisting of cyano, nitro, haloalkoxy, hydroxy, amino, alkyl substituted with 0-2  $R_6$ , alkenyl substituted with 0-2  $R_6$ , alkynyl substituted with 0-2  $R_6$ , alkoxy substituted with 0-2  $R_6$ ,  $-NH(alkyl)$  substituted with 0-2  $R_6$ ,  $-N(alkyl)(alkyl)$  where each alkyl is independently substituted with 0-2  $R_6$ ,  $-XR_7$ , and  $Y$ ;

15  $R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano, alkyl, alkoxy,  $-NH(alkyl)$ ,  $-N(alkyl)(alkyl)$ ,  $-S(O)_n(alkyl)$ , haloalkyl, haloalkoxy,  $CO(alkyl)$ ,  $CONH(alkyl)$ ,  $CON(alkyl_1)(alkyl_2)$  where  $alkyl_1$  and  $alkyl_2$  may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and  $Y$ ;

20  $R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano, alkyl, alkoxy,  $-NH(alkyl)$ ,  $-N(alkyl)(alkyl)$ ,  $-S(O)_n(alkyl)$ , haloalkyl, haloalkoxy,  $CO(alkyl)$ ,  $CONH(alkyl)$ ,  $CON(alkyl_1)(alkyl_2)$  where  $alkyl_1$  and  $alkyl_2$  may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and  $Y$ ;

25  $R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano, alkyl, alkoxy,  $-NH(alkyl)$ ,  $-N(alkyl)(alkyl)$ ,  $-S(O)_n(alkyl)$ , haloalkyl, haloalkoxy,  $CO(alkyl)$ ,  $CONH(alkyl)$ ,  $CON(alkyl_1)(alkyl_2)$  where  $alkyl_1$  and  $alkyl_2$  may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and  $Y$ ;

X is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>8</sub>-, -C(=O)-, -C(=O)O-, -C(=O)NH-, -C(=O)NR<sub>8</sub>-, -S(O)<sub>n</sub>NH-, -S(O)<sub>n</sub>NR<sub>8</sub>-, NHC(=O)-, -NR<sub>8</sub>C(=O)-, -NHS(O)<sub>n</sub>-, and -NR<sub>8</sub>S(O)<sub>n</sub>;

5 R<sub>7</sub> and R<sub>8</sub> are independently selected at each occurrence from hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or

10 one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(alkyl),

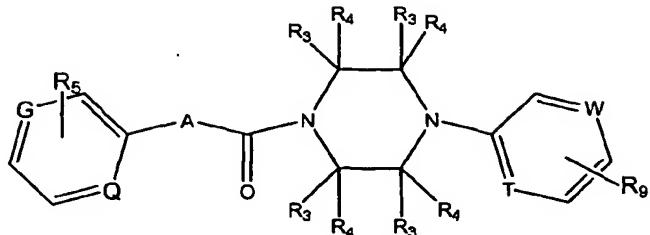
15 -N(alkyl)C(O)(alkyl), -NHS(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>NH(alkyl), -S(O)<sub>n</sub>N(alkyl<sub>3</sub>)(alkyl<sub>4</sub>) where alkyl<sub>3</sub> and alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

20 Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, alkyl, alkoxy, haloalkyl, haloalkoxy, mono- or dialkylamino, and alkylthio;

25 wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and

30 n is independently chosen at each occurrence from 0, 1, and 2.

## 9. A compound of the formula:



5 or a pharmaceutically acceptable salt thereof, wherein:

G, Q, T, and W are the same or different and are selected from the group consisting of N, CH, and CR<sub>5</sub>, wherein T or W or both is N;

A is absent or is selected from the group consisting of O, S, 10 NR<sub>A</sub>, CR<sub>B</sub>R<sub>B</sub>', NR<sub>A</sub>CR<sub>B</sub>R<sub>B</sub>', CR<sub>B</sub> R<sub>B</sub>'NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub>, R<sub>B</sub>, and R<sub>B</sub>' are independently selected at each occurrence from hydrogen or alkyl;

Z is oxygen or sulfur;

R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the 15 group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted C<sub>1-6</sub>alkyl; optionally substituted C<sub>2-6</sub>alkenyl; optionally substituted C<sub>2-6</sub>alkynyl; optionally substituted C<sub>1-6</sub>alkoxy; optionally substituted mono or di(C<sub>1-6</sub>)alkylamino; 20 optionally substituted C<sub>1-6</sub>alkylthio; optionally substituted C<sub>1-6</sub>alkylester; optionally substituted C<sub>1-6</sub>alkylsulfinyl; optionally substituted C<sub>1-6</sub>alkylsulfonyl; optionally substituted mono- or di(C<sub>1-6</sub>)alkylcarboxamide; optionally substituted -S(O)<sub>n</sub>NH C<sub>1-6</sub>alkyl; optionally substituted -S(O)<sub>n</sub>N(C<sub>1-6</sub>alkyl) (C<sub>1-6</sub>alkyl); optionally substituted -NHC(=O) 25 C<sub>1-6</sub>alkyl; optionally substituted -NC(=O) (C<sub>1-6</sub>alkyl) (C<sub>1-6</sub>alkyl);

6 alkyl); optionally substituted  $-\text{NHS(O)}_n\text{C}_{1-6}\text{alkyl}$ ;  
optionally substituted  $-\text{NS(O)}_n(\text{C}_{1-6}\text{alkyl})(\text{C}_{1-6}\text{alkyl})$ ;  
optionally substituted saturated or partially unsaturated  
5 heterocycloalkyl of from 5 to 8 atoms, which saturated or  
partially unsaturated heterocycloalkyl contains 1, 2, or 3  
heteroatoms selected from N, O, and S; optionally  
substituted aryl having from 1 to 3 rings; and optionally  
substituted heteroaryl, said heteroaryl having from 1 to 3  
10 rings, 5 to 8 ring members in each ring and, in at least  
one of said rings, from 1 to about 3 heteroatoms per ring  
selected from the group consisting of N, O, and S;

15 or any two

15  $\text{R}_3$  and  $\text{R}_4$  not attached to the same carbon may be joined to form  
an optionally substituted aryl ring; a saturated or  
partially unsaturated carbocyclic ring of from 5 to 8  
members, which carbocyclic ring is optionally substituted;  
or a saturated, partially unsaturated, or aromatic  
heterocyclic ring of from 5 to 8 members, which  
heterocyclic ring is optionally substituted and contains  
20 1, 2, or 3 heteroatoms selected from N, O, and S;

25  $\text{R}_5$  represents 1 to 3 substituents and is independently selected  
at each occurrence from the group consisting of cyano,  
hydroxy, amino,  $\text{C}_{3-6}$  alkyl substituted with 0-2  $\text{R}_6$ ,  $\text{C}_{2-6}$   
alkenyl substituted with 0-2  $\text{R}_6$ ,  $\text{C}_{2-6}$  alkynyl substituted  
with 0-2  $\text{R}_6$ ,  $\text{C}_{3-6}$  alkoxy substituted with 0-2  $\text{R}_6$ ,  $-\text{NH}(\text{C}_{1-6}\text{alkyl})$   
where each alkyl is independently substituted with 0-2  $\text{R}_6$ ,  
 $-\text{XR}_7$ , and Y;

30  $\text{R}_9$  represents 0 to 3 substituents and is independently selected  
at each occurrence from the group consisting of halogen,  
cyano, nitro, halo( $\text{C}_{1-6}$ )alkyl, halo( $\text{C}_{1-6}$ )alkoxy, hydroxy,

amino,  $C_{1-6}$ alkyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ,  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ ,  $-NH(C_{1-6}$ alkyl) substituted with 0-2  $R_6$ ,  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl) where each  $C_{1-6}$ alkyl is independently substituted with 0-2  $R_6$ ,  $-XR_7$ , and  $Y$ ;

5  $R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy,  $-NH(C_{1-4}$ alkyl),  $-N(C_{1-4}$ alkyl)( $C_{1-4}$ alkyl),  $-S(O)_n(C_{1-4}$ alkyl), halo( $C_{1-4}$ )alkyl, halo( $C_{1-4}$ )alkoxy,  $CO(C_{1-4}$ alkyl),  $CONH(C_{1-4}$ alkyl),  $CON(C_{1-4}$ alkyl $_1$ )( $C_{1-4}$ alkyl $_2$ ) where alkyl $_1$  and alkyl $_2$  may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S,  $-XR_7$ , and  $Y$ ;

10 15  $X$  is independently selected at each occurrence from the group consisting of  $-CH_2-$ ,  $-CHR_8-$ ,  $-O-$ ,  $-S(O)_n-$ ,  $-NH-$ ,  $-NR_8-$ ,  $-C(=O)-$ ,  $-C(=O)O-$ ,  $-C(=O)NH-$ ,  $-C(=O)NR_8-$ ,  $-S(O)_nNH-$ ,  $-S(O)_nNR_8-$ ,  $NHC(=O)-$ ,  $-NR_8C(=O)-$ ,  $-NHS(O)_n-$ , and  $-NR_8S(O)_n-$ ;

15  $R_7$  and  $R_8$  are independently selected at each occurrence from 20 hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 1 to 8 25 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy,  $-O(C_{1-4}$ alkyl),  $-NH(C_{1-4}$ alkyl),  $-N(C_{1-4}$ alkyl)( $C_{1-4}$ alkyl),  $-NHC(O)(C_{1-4}$ alkyl),  $-N(C_{1-4}$ alkyl)C(O)( $C_{1-4}$ alkyl),  $-NHS(O)_n(C_{1-4}$ alkyl),  $-S(O)_n(C_{1-4}$ alkyl),  $-S(O)_nNH(C_{1-4}$ alkyl),  $-S(O)_nN(C_{1-4}$ alkyl $_3$ ) (  $C_{1-4}$ alkyl $_4$ ) where  $C_{1-4}$ alkyl $_3$  and  $C_{1-4}$ alkyl $_4$

may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y'; Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, 5 mono- or di(C<sub>1-4</sub>)alkylamino, and C<sub>1-4</sub>alkylthio; wherein said 10 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and n is independently chosen at each occurrence from 0, 1, and 2.

10. A compound according to Claim 9, which is 4-(3-Chloro-2-pyridinyl)-N-[4(isopropyl)phenyl]-2-methylthio-1-piperazinecarboxamide, or a pharmaceutically acceptable salt 15 thereof.

11. A compound according to Claim 9, wherein R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group 20 consisting of hydrogen and C<sub>1-6</sub> alkyl.

12. A compound according to Claim 11, wherein G and Q are selected from the group consisting of CH and CR<sub>5</sub>.

13. A compound according to Claim 11, wherein G, Q, and W 25 are independently selected at each occurrence from the group consisting of CH and CR<sub>5</sub>; and T is N.

14. A compound according to Claim 13 wherein R<sub>3</sub> and R<sub>4</sub> are hydrogen; and A is selected from the group consisting of NH, -CH=CH-, and -CH<sub>2</sub>NH-.

15. A compound or salt according to Claim 14, wherein R<sub>6</sub> is 30 independently selected at each occurrence from the group

consisting of halogen, hydroxy,  $C_{1-4}$  alkyl,  $C_{1-4}$  alkoxy,  $-NH(C_{1-4}alkyl)$ , and  $-N(C_{1-4} alkyl)(C_{1-4} alkyl)$ .

16. A compound according to Claim 14, which is 4-(3-Trifluoromethyl-2-pyridinyl)-N-(3-methoxy-4-

5 hydroxyphenylmethyl)-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

17. A compound according to Claim 14, which is 4-(3-Nitro-pyridinyl)-N-[4-(n-butyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

10 18. A compound according to Claim 14, which is 4-(3-Trifluoromethyl-2-pyridinyl)-N-[4-(n-butyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

15 19. A compound according to Claim 14, which is 4-(3-Methyl-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

20 20. A compound according to Claim 14, which is 4-(3-Methyl-2-pyridinyl)-N-[4-(n-butyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

21. A compound according to Claim 14, which is 4-(3-Chloro-5-trifluoromethyl-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

25 22. A compound according to Claim 14, which is 4-(3-Chloro-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

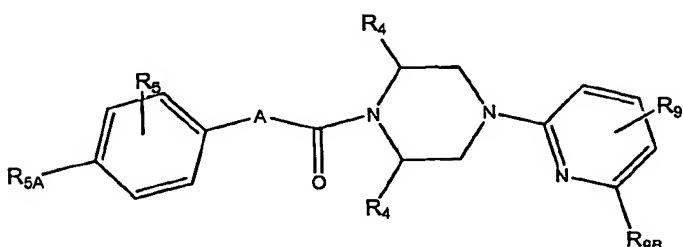
23. A compound according to Claim 14, which is 4-(3,5-Dichloro-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

30

24. A compound according to claim 13, which is 4-(3-Cyano-2-pyridinyl)-N-[4-(isopropyl)phenyl]-1-piperazinecarboxamide, or a pharmaceutically acceptable salt thereof.

25. The compound according to claim 13, which is 4-(3-Chloro-2-pyridinyl)-N-[4-(isopropyl)phenyl]-2-methyl-1-piperazinecarboxamide.

26. A compound of the formula:



10

or a pharmaceutically acceptable salt thereof, wherein:  
A is selected from the group consisting of NH, -CH=CH-, and  
CH<sub>2</sub>NH;

15 R<sub>5</sub> represents 0 to 2 substituents and is independently chosen at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub> alkyl is independently substituted with 0-2 R<sub>6</sub>;

20 R<sub>9</sub> represents 0 to 2 substituents and is independently chosen at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl

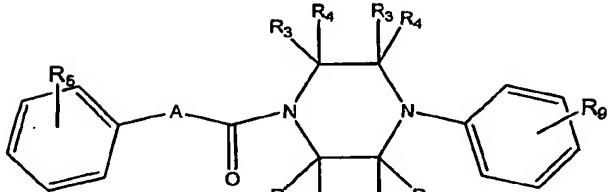
substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>; and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>;

5 R<sub>5A</sub> is independently selected from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub> alkyl, C<sub>1-6</sub> alkoxy, -NH(C<sub>1-6</sub> alkyl), and -N(C<sub>1-6</sub> alkyl)(C<sub>1-6</sub> alkyl);

10 R<sub>9B</sub> is independently selected from the group consisting of halogen, nitro, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub> alkyl, C<sub>1-6</sub> alkoxy, -NH(C<sub>1-6</sub> alkyl), and -N(C<sub>1-6</sub> alkyl)(C<sub>1-6</sub> alkyl); and

15 R<sub>6</sub> is independently selected at each occurrence the group consisting of halogen, hydroxy, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub> alkyl), and -N(C<sub>1-4</sub> alkyl)(C<sub>1-4</sub> alkyl).

27. A compound of the formula:



20

or a pharmaceutically acceptable salt thereof, wherein:

A is selected from the group consisting of a single bond, S, NR<sub>A</sub>, CHR<sub>B</sub>, NR<sub>A</sub>CHR<sub>B</sub>, CHR<sub>B</sub>NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub> and R<sub>B</sub> are independently selected at each occurrence from the group consisting of hydrogen and alkyl;

25 R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group consisting of hydrogen; halogen; hydroxy; amino; cyano; nitro; -COOH; -CHO, optionally substituted alkyl;

optionally substituted alkenyl; optionally substituted alkynyl; optionally substituted alkoxy; optionally substituted mono or dialkylamino; optionally substituted alkylthio; optionally substituted alkyl ketone; optionally substituted alkylester; optionally substituted alkylsulfinyl; optionally substituted mono- or di-alkylcarboxamide; optionally substituted  $-S(O)_nNHalkyl$ ; optionally substituted  $-S(O)_nN(alkyl)(alkyl)$ ; optionally substituted  $NHC(=O)alkyl$ ; optionally substituted  $NC(=O)(alkyl)(alkyl)$ ; optionally substituted  $-NHS(O)_nalkyl$ ; optionally substituted  $-NS(O)_n(alkyl)(alkyl)$ ; optionally substituted saturated or partially unsaturated heterocycloalkyl of from 5 to 8 atoms, which saturated or partially unsaturated heterocycloalkyl contains 1, 2, or 3 heteroatoms selected from N, O, and S; optionally substituted aryl having from 1 to 3 rings; and optionally substituted heteroaryl, said heteroaryl having from 1 to 3 rings, 5 to 8 ring members in each ring and, in at least one of said rings, from 1 to about 3 heteroatoms per ring selected from the group consisting of N, O, and S;

or any two

$R_3$  and  $R_4$  not attached to the same carbon may be joined to form an optionally substituted aryl ring; a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is optionally substituted; or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is optionally substituted and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

R<sub>5</sub> is independently selected at each occurrence from the group consisting of cyano, nitro, haloalkyl, haloalkoxy, C<sub>1-6</sub> alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub> alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub> alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub> alkyl)(C<sub>1-6</sub> alkyl) where each alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

R<sub>9</sub> represents 0-3 substituents and is independently selected at each occurrence from the group consisting of bromo, haloalkyl, haloalkoxy, hydroxy, C<sub>2-6</sub> alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub> alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>2-6</sub> alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>2-6</sub> alkyl)(C<sub>2-6</sub> alkyl) where each C<sub>2-6</sub> alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

R<sub>6</sub> is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano, alkyl, alkoxy, -NH(alkyl), -N(alkyl)(alkyl), -S(O)<sub>n</sub>(alkyl), haloalkyl, haloalkoxy, CO(alkyl), CONH(alkyl), CON(alkyl<sub>1</sub>)(alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, -XR<sub>7</sub>, and Y;

X is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>8</sub>-, -C(=O)-, -C(=O)O-, -C(=O)NH-, -C(=O)NR<sub>8</sub>-, -S(O)<sub>n</sub>NH-, -S(O)<sub>n</sub>NR<sub>8</sub>-, NHC(=O)-, -NR<sub>8</sub>C(=O)-, -NHS(O)<sub>n</sub>-, and -NR<sub>8</sub>S(O)<sub>n</sub>;

R<sub>7</sub> and R<sub>8</sub> are independently selected at each occurrence from straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups

consisting of 3 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 3 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(alkyl), -NH(alkyl), -N(alkyl)(alkyl), -NHC(O)(alkyl), -N(alkyl)C(O)(alkyl), -NHS(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>(alkyl), -S(O)<sub>n</sub>NH(alkyl), -S(O)<sub>n</sub>N(alkyl<sub>3</sub>)(alkyl<sub>4</sub>)

5 where alkyl<sub>3</sub> and alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

10 Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, alkyl, alkoxy, haloalkyl, haloalkoxy, mono- or

15 dialkylamino, and alkylthio;

20 wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and

25 n is independently chosen at each occurrence from 0, 1, and 2.

28. A compound or salt according to Claim 27 in which R<sub>3</sub> and R<sub>4</sub> are independently selected at each occurrence from the group consisting of hydrogen and C<sub>1-6</sub> alkyl.

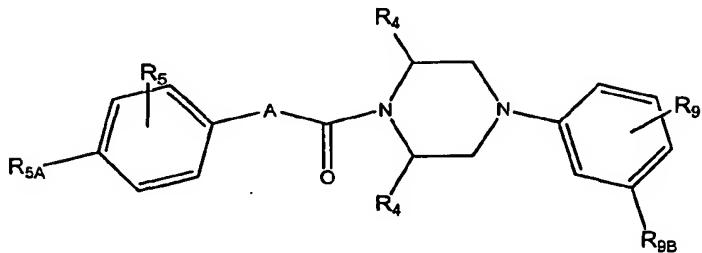
29. A compound or salt according to claim 27, wherein A is selected from the group consisting of NH, -CH=CH-, and CH<sub>2</sub>NH; R<sub>3</sub> is hydrogen and R<sub>4</sub> is independently chosen at each occurrence from hydrogen and methyl; and R<sub>6</sub> is independently selected at

30

each occurrence from the group consisting of halogen, hydroxy, C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkoxy, -NH(C<sub>1-4</sub> alkyl), and -N(C<sub>1-4</sub> alkyl)(C<sub>1-4</sub> alkyl).

30. A compound of the formula:

5



or a pharmaceutically acceptable salt thereof, wherein:

A is selected from the group consisting of NH, -CH=CH-, and

10 CH<sub>2</sub>NH;

R<sub>4</sub> is independently selected at each occurrence from hydrogen and C<sub>1-4</sub>alkyl;

R<sub>5</sub> represents 0 to 2 substituents independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>;

R<sub>9</sub> represents 0 to 2 substituents and is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl)

substituted with 0-2 R<sub>6</sub>, and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>;

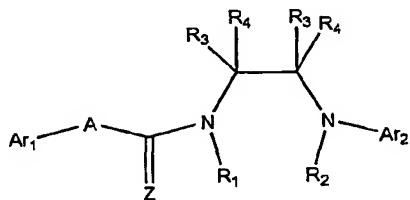
R<sub>5A</sub> is independently selected from the group consisting of halogen, cyano, nitro, trifluoromethyl, trifluoromethoxy, hydroxy, amino, C<sub>1-6</sub> alkyl, C<sub>1-6</sub> alkoxy, -NH(C<sub>1-6</sub> alkyl), and -N(C<sub>1-6</sub> alkyl)(C<sub>1-C<sub>6</sub></sub> alkyl);

R<sub>9B</sub> is independently selected from the group consisting of trifluoromethoxy, hydroxy, C<sub>2-6</sub> alkyl, C<sub>2-6</sub> alkoxy, -NH(C<sub>2-6</sub> alkyl), and -N(C<sub>2-6</sub> alkyl)(C<sub>2-6</sub> alkyl); and

10 R<sub>6</sub> is independently selected at each occurrence from the group consisting of halogen, hydroxy, C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkoxy, -NH(C<sub>1-4</sub> alkyl), and -N(C<sub>1-4</sub> alkyl)(C<sub>1-4</sub> alkyl).

31. A compound of the formula:

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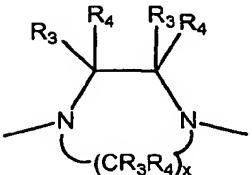


or a pharmaceutically acceptable salt thereof, wherein the compound or pharmaceutically acceptable salt thereof exhibits an EC<sub>50</sub> or K<sub>i</sub> of 1 micromolar or less in a standard assay of capsaicin receptor mediated calcium mobilization; and wherein

A is absent or is selected from the group consisting of O, S, NR<sub>A</sub>, CR<sub>B</sub>R<sub>B</sub>', CR<sub>B</sub>R<sub>B</sub>'NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub>, R<sub>B</sub>, and R<sub>B</sub>' are independently selected at each occurrence from hydrogen or C<sub>1-6</sub> alkyl;

Z is oxygen or sulfur;

R<sub>1</sub> and R<sub>2</sub> independently represent hydrogen or C<sub>1-6</sub> alkyl; or R<sub>1</sub> and R<sub>2</sub> are taken together to form a 5 to 8 membered nitrogen-containing ring of the formula:



5 wherein x is 1, 2, or 3;

R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>; C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>; C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>,

10 R<sub>6</sub>; -N(C<sub>1-6</sub>alkyl) (C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>,

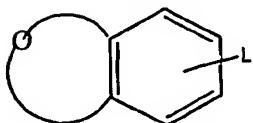
15 -XR<sub>7</sub>, and Y;  
or any two

R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an aryl ring substituted with 0-3 R<sub>6</sub>, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is substituted with 0-2 R<sub>6</sub>, or a saturated, partially unsaturated, or aromatic heterocyclic ring of from 5 to 8 members, which heterocyclic ring is substituted with 0-2 R<sub>6</sub> and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

20 25 Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and are selected from the group consisting of cyclohexyl, cyclopentyl, piperidinyl, piperazinyl, phenyl, pyrrolyl, furanyl, thieryl, pyrazolyl, imidazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, oxadiazolyl, triazolyl, tetrazolyl,

pyridyl, pyrimidyl, pyrazinyl, benzimidazolyl, naphthyl, indolyl, isoindolyl, benzofuranyl, isobenzofuranyl, benzo[b]thiophenyl, benz[d]isoxazolyl, quinolinyl, isoquinolinyl, cinnolinyl, quinazolinyl, and quinoxalinyl, each of which is optionally mono-, di-, or trisubstituted with  $R_5$ ; or

Ar<sub>1</sub> and Ar<sub>2</sub> may be the same or different and represent a bicyclic oxygen-containing group of the formula:



optionally mono-, di-, or trisubstituted with  $R_5$ , where L represents point of attachment and may be at any point on the benzene ring, and the oxygen-containing ring of the bicyclic oxygen-containing group consists of from 5 to 8 ring atoms, contains 1 or 2 oxygen atoms and remaining ring atoms are carbon;

$R_5$  is independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2  $R_6$ , C<sub>2-6</sub>alkenyl substituted with 0-2  $R_6$ , C<sub>2-6</sub>alkynyl substituted with 0-2  $R_6$ , C<sub>1-6</sub>alkoxy substituted with 0-2  $R_6$ , -NH(C<sub>1-6</sub>alkyl) substituted with 0-2  $R_6$ , -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2  $R_6$ , -XR<sub>7</sub>, and Y;

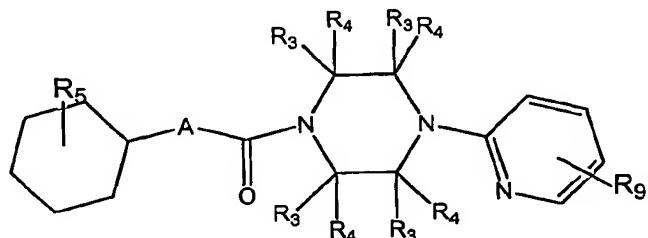
$R_6$  is independently selected at each occurrence from the group consisting of halogen, hydroxy, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, CO(C<sub>1-4</sub>alkyl), CONH(C<sub>1-4</sub>alkyl), CON(C<sub>1-4</sub>alkyl<sub>1</sub>)(C<sub>1-4</sub>alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of

from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, -XR<sub>7</sub>, and Y; X is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>8</sub>-, -C(=O)-, -C(=O)O-, -C(=O)NH-, -C(=O)NR<sub>8</sub>-, -S(O)<sub>n</sub>NH-, -S(O)<sub>n</sub>NR<sub>8</sub>-, NHC(=O)-, -NR<sub>8</sub>C(=O)-, -NHS(O)<sub>n</sub>-, and -NR<sub>8</sub>S(O)<sub>n</sub>-; 5 R<sub>7</sub> and R<sub>8</sub> are independently selected at each occurrence from hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and 10 cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, 15 halogen, amino, cyano, nitro, haloalkyl, haloalkoxy, -O(C<sub>1-4</sub>alkyl), -NH(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl), -NHC(O)(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl)C(O)(C<sub>1-4</sub>alkyl), -NHS(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>NH(C<sub>1-4</sub>alkyl), 20 -S(O)<sub>n</sub>N(C<sub>1-4</sub>alkyl<sub>3</sub>)(C<sub>1-4</sub>alkyl<sub>4</sub>) where C<sub>1-4</sub>alkyl<sub>3</sub> and C<sub>1-4</sub>alkyl<sub>4</sub> may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y'; 25 Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, 30 mono- or di(C<sub>1-4</sub>)alkylamino, and C<sub>1-4</sub>alkylthio;

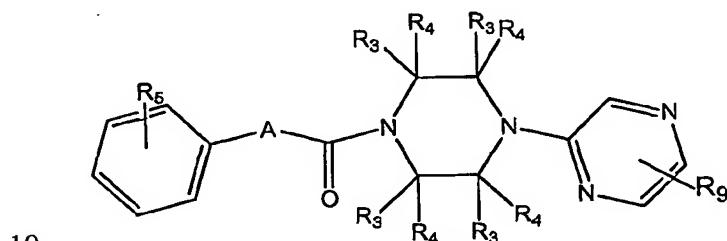
wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and

n is independently chosen at each occurrence from 0, 1, and 2.

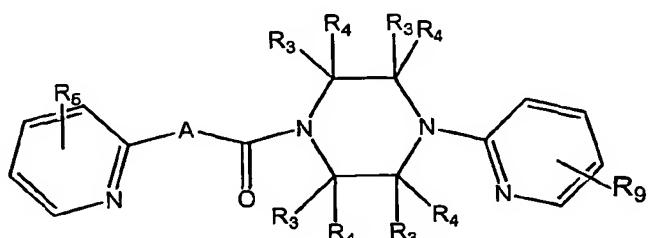
5 32. A compound of the Formula A, Formula B, Formula C, Formula D, Formula E, or Formula F:



Formula A

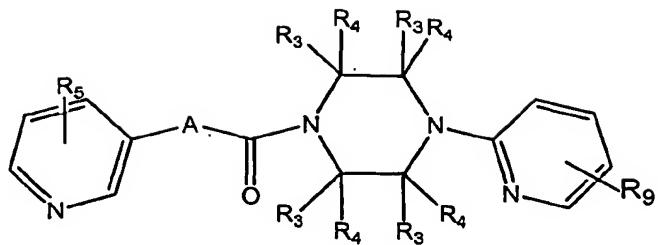


10 Formula B

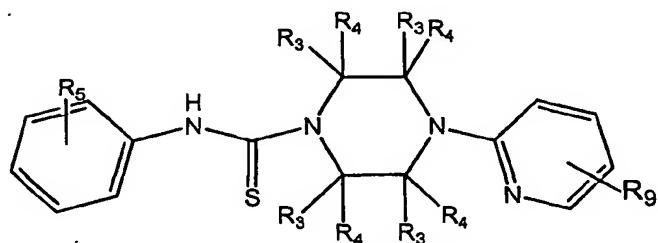


Formula C

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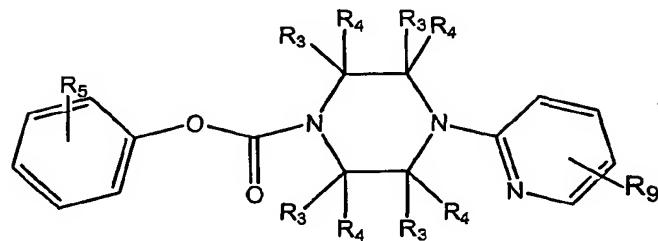


Formula D



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Formula E



Formula F

10 or a pharmaceutically acceptable salt of Formula A, Formula B, Formula C, Formula D, Formula E, or Formula F, wherein A represents NH or O;

15 R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>; C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>; C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>,

-N(C<sub>1-6</sub>alkyl) (C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

or any two

5 R<sub>3</sub> and R<sub>4</sub> not attached to the same carbon may be joined to form an aryl ring substituted with 0-3 R<sub>6</sub>, a saturated or partially unsaturated carbocyclic ring of from 5 to 8 members, which carbocyclic ring is substituted with 0-2 R<sub>6</sub>, or a saturated, partially unsaturated, or aromatic 10 heterocyclic ring of from 5 to 8 members, which heterocyclic ring is substituted with 0-2 R<sub>6</sub> and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

R<sub>5</sub> and R<sub>9</sub> each represent from 1 to 3 substituents and are independently selected at each occurrence from the group 15 consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>alkyl), halo(C<sub>1-6</sub>alkoxy), hydroxy, amino, C<sub>1-6</sub>alkyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-2 R<sub>6</sub>, C<sub>2-6</sub>alkynyl substituted with 0-2 R<sub>6</sub>, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl) substituted with 0-2 R<sub>6</sub>, -N(C<sub>1-6</sub>alkyl) (C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is independently substituted 20 with 0-2 R<sub>6</sub>, -XR<sub>7</sub>, and Y;

R<sub>6</sub> is independently selected at each occurrence from the group 25 consisting of halogen, hydroxy, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub>alkyl), -N(C<sub>1-4</sub>alkyl) (C<sub>1-4</sub>alkyl), -S(O)<sub>n</sub>(C<sub>1-4</sub>alkyl), halo(C<sub>1-4</sub>alkyl), halo(C<sub>1-4</sub>alkoxy), CO(C<sub>1-4</sub>alkyl), CONH(C<sub>1-4</sub>alkyl), CON(C<sub>1-4</sub>alkyl<sub>1</sub>) (C<sub>1-4</sub>alkyl<sub>2</sub>) where alkyl<sub>1</sub> and alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, -XR<sub>7</sub>, and Y;

30 X is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>9</sub>-, -

$C(=O)-$ ,  $-C(=O)O-$ ,  $-C(=O)NH-$ ,  $-C(=O)NR_8-$ ,  $-S(O)_nNH-$ ,  $-S(O)_nNR_8-$ ,  $NHC(=O)-$ ,  $-NR_8C(=O)-$ ,  $-NHS(O)_n-$ , and  $-NR_8S(O)_n-$ ;

$R_7$  and  $R_8$  are independently selected at each occurrence from hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy,  $-O(C_{1-4}alkyl)$ ,  $-NH(C_{1-4}alkyl)$ ,  $-N(C_{1-4}alkyl)(C_{1-4}alkyl)$ ,  $-NHC(O)(C_{1-4}alkyl)$ ,  $-N(C_{1-4}alkyl)C(O)(C_{1-4}alkyl)$ ,  $-NHS(O)_n(C_{1-4}alkyl)$ ,  $-S(O)_n(C_{1-4}alkyl)$ ,  $-S(O)_nNH(C_{1-4}alkyl)$ ,  $-S(O)_nN(C_{1-4}alkyl_3)(C_{1-4}alkyl_4)$  where  $C_{1-4}alkyl_3$  and  $C_{1-4}alkyl_4$  may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y';

Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano,  $C_{1-4}alkyl$ ,  $C_{1-4}alkoxy$ ,  $halo(C_{1-4})alkyl$ ,  $halo(C_{1-4})alkoxy$ , mono- or di( $C_{1-4}$ )alkylamino, and  $C_{1-4}alkylthio$ ;

wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and

n is independently chosen at each occurrence from 0, 1, and 2.

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33. A compound or salt according to Claim 32, wherein A represents NH.

34. A compound or salt according to Claim 32, wherein:  
A represents NH; and

5 R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy substituted with 0-2 R<sub>6</sub>, -NH(C<sub>1-6</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl).

10 35. A compound or salt according to Claim 32, wherein:  
A represents NH;  
R<sub>3</sub> represents hydrogen; and  
R<sub>4</sub> is independently chosen at each occurrence from hydrogen and C<sub>1-6</sub> alkyl.

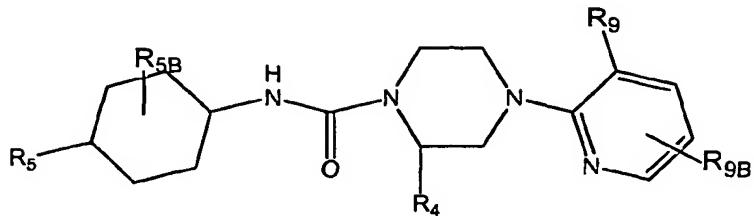
15 36. A compound or salt according to Claim 32, wherein:  
A represents NH;  
R<sub>3</sub> represents hydrogen; and  
R<sub>4</sub> is independently chosen at each occurrence from hydrogen and methyl.

20 37. A compound or salt according to Claim 32, wherein:  
A represents NH;  
R<sub>3</sub> represents hydrogen;  
R<sub>4</sub> is independently chosen at each occurrence from hydrogen and methyl; and

25 R<sub>5</sub> and R<sub>9</sub> each represent from 1 to 3 substituents independently selected at each occurrence from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl), and C<sub>3-8</sub> cycloalkyl.

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38. A compound or salt according to Claim 37 of the Formula A-1



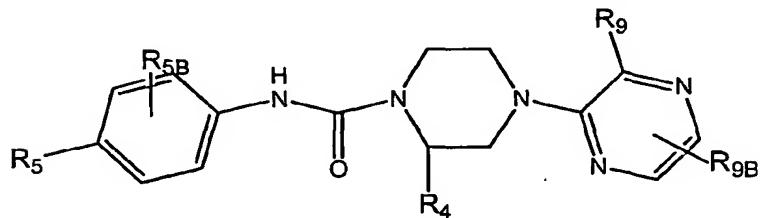
Formula A-1

5 R<sub>5</sub> and R<sub>9</sub> are independently selected from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl), and C<sub>3-8</sub> cycloalkyl; and

10 R<sub>5B</sub> and R<sub>9B</sub> each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, hydroxy, amino, C<sub>1-3</sub>alkyl, C<sub>1-3</sub>alkoxy, -NH(C<sub>1-3</sub>alkyl), and -N(C<sub>1-3</sub>alkyl)(C<sub>1-3</sub>alkyl).

15 39. A compound or salt according to Claim 38, wherein:  
R<sub>5</sub> is C<sub>3-6</sub> alkyl; C<sub>3-6</sub> alkoxy; halo(C<sub>1-3</sub>)alkyl, halo(C<sub>1-3</sub>)alkoxy, or C<sub>3-8</sub> cycloalkyl;  
R<sub>9</sub> is chloro or trifluoromethyl; and  
R<sub>5B</sub> and R<sub>9B</sub> are hydrogen.

20 40. A compound or salt according to Claim 37 of Formula B-1



Formula B-1

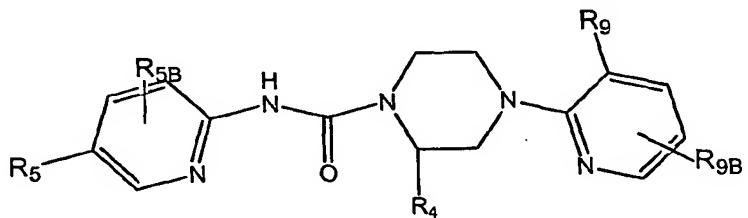
wherein

R<sub>5</sub> and R<sub>9</sub> are independently selected from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl), and C<sub>3-8</sub> cycloalkyl; and

5 R<sub>5B</sub> and R<sub>9B</sub> each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, hydroxy, amino, C<sub>1-3</sub>alkyl, C<sub>1-3</sub>alkoxy, -NH(C<sub>1-3</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl).

10 41. A compound or salt according to Claim 40, wherein:  
R<sub>5</sub> is C<sub>3-6</sub> alkyl; C<sub>3-6</sub> alkoxy; halo(C<sub>1-3</sub>)alkyl, halo(C<sub>1-3</sub>)alkoxy, or C<sub>3-8</sub> cycloalkyl;  
R<sub>9</sub> is chloro or trifluoromethyl; and  
15 R<sub>5B</sub> and R<sub>9B</sub> are hydrogen.

42. A compound or salt according to Claim 37 of Formula C-1:



Formula C-1

20 wherein:

R<sub>5</sub> and R<sub>9</sub> are independently selected from the group consisting of halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl), and C<sub>3-8</sub> cycloalkyl; and

25 R<sub>5B</sub> and R<sub>9B</sub> each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, hydroxy, amino,

$C_{1-3}$ alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}$ alkyl), and  $-N(C_{1-6}$ alkyl) ( $C_{1-6}$ alkyl).

43. A compound or salt according to Claim 42, wherein:

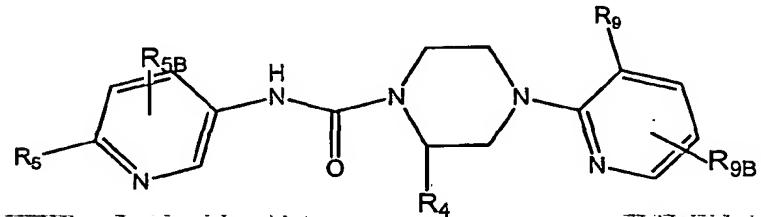
$R_5$  is  $C_{3-6}$  alkyl;  $C_{3-6}$  alkoxy; halo( $C_{1-3}$ )alkyl, halo( $C_{1-3}$ )alkoxy,

5 or  $C_{3-8}$  cycloalkyl;

$R_9$  is chloro or trifluoromethyl; and

$R_{5B}$  and  $R_{9B}$  are hydrogen.

44. A compound or salt according to Claim 37 of Formula D-1



10 Formula D-1

wherein:

$R_5$  and  $R_9$  are independently selected from the group consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}$ alkyl),  $-N(C_{1-6}$ alkyl) ( $C_{1-6}$ alkyl), and  $C_{3-8}$  cycloalkyl; and

$R_{5B}$  and  $R_{9B}$  each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, hydroxy, amino,  $C_{1-3}$ alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}$ alkyl), and  $-N(C_{1-6}$ alkyl) ( $C_{1-6}$ alkyl).

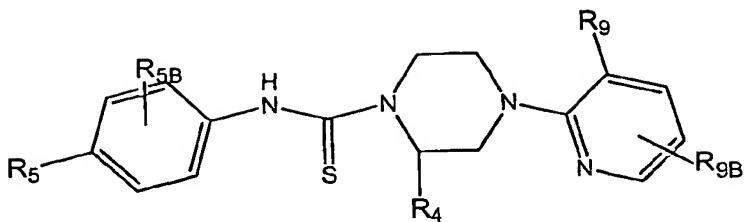
45. A compound or salt according to Claim 44, wherein:

$R_5$  is  $C_{3-6}$  alkyl;  $C_{3-6}$  alkoxy; halo( $C_{1-3}$ )alkyl, halo( $C_{1-3}$ )alkoxy, or  $C_{3-8}$  cycloalkyl;

25  $R_9$  is chloro or trifluoromethyl; and

$R_{5B}$  and  $R_{9B}$  are hydrogen.

46. A compound or salt according to Claim 37, of Formula E-1



Formula E-1

wherein:

5  $R_5$  and  $R_9$  are independently selected from the group consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}$ alkyl),  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl), and  $C_{3-8}$  cycloalkyl; and

10  $R_{5B}$  and  $R_{9B}$  each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, hydroxy, amino,  $C_{1-3}$ alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}$ alkyl), and  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl).

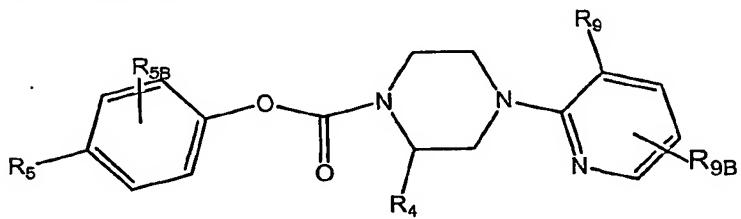
47. A compound or salt according to Claim 46, wherein:

15  $R_5$  is  $C_{3-6}$  alkyl;  $C_{3-6}$  alkoxy; halo( $C_{1-3}$ )alkyl, halo( $C_{1-3}$ )alkoxy, or  $C_{3-8}$  cycloalkyl;

$R_9$  is chloro or trifluoromethyl; and

$R_{5B}$  and  $R_{9B}$  are hydrogen.

48. A compound of salt according to Claim 37 of Formula F-1



20

Formula F-1

wherein:

$R_5$  and  $R_9$  are independently selected from the group consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy,

hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}$ alkyl),  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl), and  $C_{3-8}$ cycloalkyl; and

5  $R_{5B}$  and  $R_{9B}$  each represent up to 2 substituents independently selected at each occurrence from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, hydroxy, amino,  $C_{1-3}$ alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}$ alkyl), and  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl).

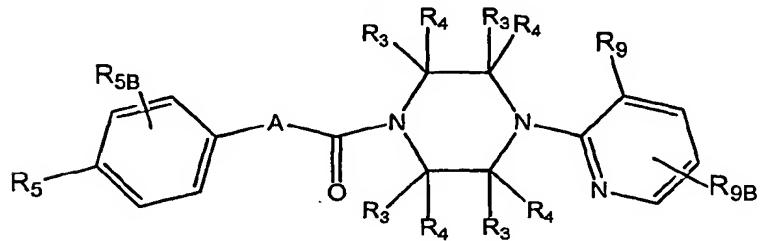
49. A compound or salt according to Claim 47, wherein:

10  $R_5$  is  $C_{3-6}$  alkyl;  $C_{3-6}$  alkoxy; halo( $C_{1-3}$ )alkyl, halo( $C_{1-3}$ )alkoxy, or  $C_{3-8}$  cycloalkyl;

$R_9$  is chloro or trifluoromethyl; and

$R_{5B}$  and  $R_{9B}$  are hydrogen.

50. A compound of the Formula:



15 or a pharmaceutically acceptable salt thereof, wherein:

$A$  is absent or is selected from the group consisting of  $O$ ,  $S$ ,  $NR_A$ ,  $CR_BR_B'$ ,  $NR_ACR_BR_B'$ ,  $CR_BR_B'NR_A$ ,  $-CR_A=CR_B-$ , and  $C_3H_4$ ; where  $R_A$ ,  $R_B$ , and  $R_B'$  are independently selected at each occurrence from hydrogen or  $C_{1-6}$  alkyl;

20  $R_3$  and  $R_4$  are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-2  $R_6$ ;  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ;  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ ,  $-NH(C_{1-6}$ alkyl) substituted with 0-2

$R_6$ ,  
-N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is  
independently substituted with 0-2  $R_6$ ,  
-XR<sub>7</sub>, and Y;

5 or any two

$R_3$  and  $R_4$  not attached to the same carbon may be joined to form  
an aryl ring substituted with 0-3  $R_6$ , a saturated or  
partially unsaturated carbocyclic ring of from 5 to 8  
members, which carbocyclic ring is substituted with 0-2  $R_6$ ,  
10 or a saturated, partially unsaturated, or aromatic  
heterocyclic ring of from 5 to 8 members, which  
heterocyclic ring is substituted with 0-2  $R_6$  and contains  
1, 2, or 3 heteroatoms selected from N, O, and S;

$R_5$  is selected from the group consisting of bromo, fluoro, iodo,  
15 halo(C<sub>1-6</sub>alkyl), halo(C<sub>3-6</sub>alkoxy), C<sub>3-6</sub>alkyl substituted with  
0-3  $R_6$ , C<sub>2-6</sub>alkenyl substituted with 0-3  $R_6$ , C<sub>2-6</sub>alkynyl  
substituted with 0-3  $R_6$ , C<sub>3-6</sub>alkoxy substituted with 0-2  $R_6$ ,  
(C<sub>3-8</sub>cycloalkyl)C<sub>1-4</sub>alkyl, -NH(C<sub>1-6</sub>alkyl) substituted with 0-  
20 2  $R_6$ , -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is  
substituted with 0-2  $R_6$ , Y, -(C=O)Y, -(CH<sub>2</sub>)Y, and  
-(CH(CN))Y;

$R_9$  is selected from the group consisting of halogen, cyano,  
-N(SO<sub>2</sub>C<sub>1-6</sub>alkyl)(SO<sub>2</sub>C<sub>1-6</sub>alkyl), -SO<sub>2</sub>NH<sub>2</sub>, halo(C<sub>1-6</sub>alkyl),  
halo(C<sub>1-6</sub>alkoxy), C<sub>1-6</sub>alkyl substituted with 0-2  $R_6$ ,  
25 C<sub>2-6</sub>alkenyl substituted with 0-2  $R_6$ , C<sub>2-6</sub>alkynyl substituted  
with 0-2  $R_6$ , C<sub>1-6</sub>alkoxy substituted with 0-2  $R_6$ ,  
-NH(C<sub>1-6</sub>alkyl) substituted with 0-2  $R_6$ ,  
-N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl) where each C<sub>1-6</sub>alkyl is substituted  
with 0-2  $R_6$ ;

30  $R_{5B}$  and  $R_{9B}$  each represent from 0 to 2 substituents and are  
independently selected at each occurrence from the group

consisting of halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl substituted with 0-2  $R_6$ , ( $C_{3-8}$ cycloalkyl) $C_{1-4}$ alkyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkenyl substituted with 0-2  $R_6$ ,  $C_{2-6}$ alkynyl substituted with 0-2  $R_6$ ,  $C_{1-6}$ alkoxy substituted with 0-2  $R_6$ , -NH( $C_{1-6}$ alkyl) substituted with 0-2  $R_6$ , and -N( $C_{1-6}$ alkyl)( $C_{1-6}$ alkyl) where each  $C_{1-6}$ alkyl is independently substituted with 0-2  $R_6$ , and Y; and any two

5  $R_5$  and  $R_{5B}$  bound to adjacent atoms may be joined to form a  $C_{3-8}$ cycloalkyl group or a heterocycloalkyl group, each of 10 which is optionally substituted by from 1 to 5 substituents independently chosen from cyano, halogen, hydroxy,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy, -NH( $C_{1-4}$ alkyl), -N( $C_{1-4}$ alkyl)( $C_{1-4}$ alkyl), halo( $C_{1-4}$ )alkyl, and halo( $C_{1-4}$ )alkoxy, wherein 15 the heterocycloalkyl group consists of from 4 to 8 atoms and contains 1, 2, or 3 heteroatoms selected from N, O, and S;

20  $R_6$  is independently selected at each occurrence from the group consisting of cyano, halogen, hydroxy,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy, -NH( $C_{1-4}$ alkyl), -N( $C_{1-4}$ alkyl)( $C_{1-4}$ alkyl), -S(O)<sub>n</sub>( $C_{1-4}$ alkyl), halo( $C_{1-4}$ )alkyl, halo( $C_{1-4}$ )alkoxy, CO( $C_{1-4}$ alkyl), CONH( $C_{1-4}$ alkyl), CON( $C_{1-4}$ alkyl<sub>1</sub>)( $C_{1-4}$ alkyl<sub>2</sub>) where alkyl<sub>1</sub> and 25 alkyl<sub>2</sub> may be joined to form a heterocycloalkyl ring of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, -XR<sub>7</sub>, and Y;

X is independently selected at each occurrence from the group consisting of -CH<sub>2</sub>-, -CHR<sub>8</sub>-, -O-, -S(O)<sub>n</sub>-, -NH-, -NR<sub>8</sub>-, -C(=O)-, -C(=O)NH-, -C(=O)NR<sub>8</sub>-, -S(O)<sub>n</sub>NH-, -S(O)<sub>n</sub>NR<sub>8</sub>-, NHC(=O)-, -NR<sub>8</sub>C(=O)-, -NHS(O)<sub>n</sub>-, and -NR<sub>8</sub>S(O)<sub>n</sub>;

30  $R_7$  and  $R_8$  are independently selected at each occurrence from

hydrogen, and straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups, said straight, branched, and cyclic alkyl groups, and (cycloalkyl)alkyl groups consisting of 1 to 8 carbon atoms, and containing zero or one or more double or triple bonds, each of which 1 to 8 carbon atoms may be further substituted with one or more substituent(s) independently selected from oxo, hydroxy, halogen, amino, cyano, nitro, haloalkyl, haloalkoxy,  $-O(C_{1-4}\text{alkyl})$ ,  $-\text{NH}(C_{1-4}\text{alkyl})$ ,  $-\text{N}(C_{1-4}\text{alkyl})(C_{1-4}\text{alkyl})$ ,  $-\text{NHC(O)}(C_{1-4}\text{alkyl})$ ,  $-\text{N}(C_{1-4}\text{alkyl})\text{C(O)}(C_{1-4}\text{alkyl})$ ,  $-\text{NHS(O)}_n(C_{1-4}\text{alkyl})$ ,  $-\text{S(O)}_n(C_{1-4}\text{alkyl})$ ,  $-\text{S(O)}_n\text{NH}(C_{1-4}\text{alkyl})$ ,  $-\text{S(O)}_n\text{N}(C_{1-4}\text{alkyl}_3)(C_{1-4}\text{alkyl}_4)$  where  $C_{1-4}\text{alkyl}_3$  and  $C_{1-4}\text{alkyl}_4$  may be joined to form a heterocycloalkyl ring consisting of from 5 to 8 ring atoms and containing 1, 2, or 3 heteroatoms selected from N, O, and S, and Y'; Y and Y' are independently selected at each occurrence from 3- to 8-membered carbocyclic or heterocyclic groups which are saturated, unsaturated, or aromatic, which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano,  $C_{1-4}\text{alkyl}$ ,  $C_{1-4}\text{alkoxy}$ ,  $\text{halo}(C_{1-4})\text{alkyl}$ ,  $\text{halo}(C_{1-4})\text{alkoxy}$ , mono- or di( $C_{1-4}$ )alkylamino, and  $C_{1-4}\text{alkylthio}$ ; wherein said 3- to 8-membered heterocyclic groups contain one or more heteroatom(s) independently selected from N, O, and S; and n is independently chosen at each occurrence from 0, 1, and 2.

51. A compound or salt according to Claim 50, wherein: A is O or  $\text{NR}_A$ , wherein  $R_A$  is hydrogen or methyl.

52. A compound or salt according to Claim 50, wherein: A is O or  $\text{NR}_A$ , wherein  $R_A$  is hydrogen or methyl; and

$R_3$  and  $R_4$  are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}$ alkyl), and  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl).

5 53. A compound or salt according to Claim 50, wherein:

$A$  is  $O$  or  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

10  $R_4$  is independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo( $C_{1-6}$ )alkyl, halo( $C_{1-6}$ )alkoxy, hydroxy, amino,  $C_{1-6}$ alkyl,  $C_{2-6}$ alkenyl,  $C_{2-6}$ alkynyl,  $C_{1-6}$ alkoxy,  $-NH(C_{1-6}$ alkyl), and  $-N(C_{1-6}$ alkyl)( $C_{1-6}$ alkyl).

54. A compound or salt according to Claim 50, wherein:

15  $A$  is  $O$  or  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

$R_4$  is independently chosen at each occurrence from hydrogen and  $C_{1-6}$ alkyl.

55. A compound or salt according to Claim 50, wherein:

20  $A$  is  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

$R_4$  is independently chosen at each occurrence from hydrogen, halo( $C_{1-3}$ )alkyl, and  $C_{1-6}$ alkyl.

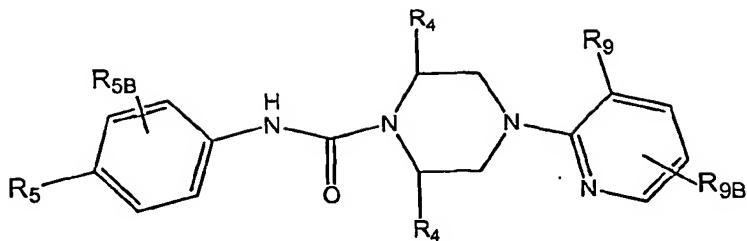
56. A compound or salt according to Claim 50, wherein:

25  $A$  is  $NR_A$ , wherein  $R_A$  is hydrogen or methyl;

$R_3$  is hydrogen; and

$R_4$  is independently chosen at each occurrence from hydrogen and  $C_{1-4}$ alkyl.

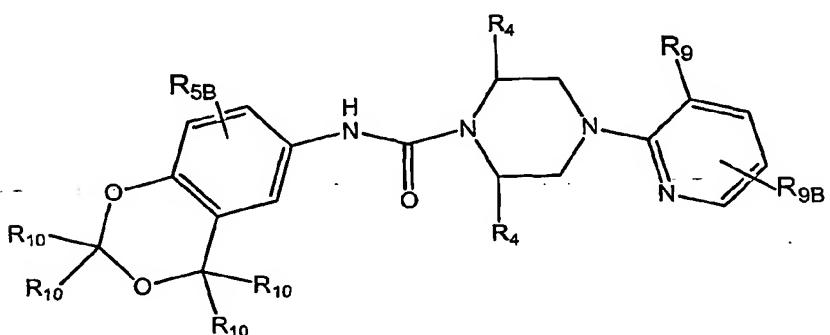
57. A compound or salt according to Claim 50 of the Formula



wherein:

$R_4$  is independently chosen at each occurrence from hydrogen and  $C_{1-4}$ alkyl.

5 58. A compound or salt according to Claim 57 of the formula:



wherein

$R_{5B}$  and  $R_{9B}$  are independently chosen from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, amino,  $C_{1-4}$ alkyl, and  $C_{1-2}$ alkoxy; and

10  $R_{10}$  is independently chosen at each occurrence from hydrogen, halogen, and  $C_{1-4}$  alkyl.

59. A compound or salt according to Claim 58 wherein:

$R_9$  is selected from the group consisting of halogen, cyano,  $15 -N(SO_2CH_3)_2$ ,  $-SO_2NH_2$ , halo( $C_{1-3}$ )alkyl,  $C_{1-3}$ alkoxy,  $-NH(C_{1-3}alkyl)$ , and  $-N(C_{1-3}alkyl)(C_{1-3}alkyl)$ .

60. A compound or salt according to Claim 57, wherein:

$R_{5B}$  and  $R_{9B}$  are independently chosen from hydrogen, halogen, cyano, nitro, halo( $C_{1-2}$ )alkyl, halo( $C_{1-2}$ )alkoxy, amino,  $C_{1-4}$ alkyl, and  $C_{1-2}$ alkoxy.

61. A compound or salt according to Claim 57, wherein:  
R<sub>5B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

5 R<sub>9B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, and C<sub>1-2</sub>alkyl, and C<sub>1-2</sub>alkoxy.

62. A compound or salt according to Claim 57, wherein:

R<sub>9</sub> is selected from the group consisting of halogen, cyano, -N(SO<sub>2</sub>CH<sub>3</sub>)<sub>2</sub>, -SO<sub>2</sub>NH<sub>2</sub>, halo(C<sub>1-3</sub>)alkyl, C<sub>1-3</sub>alkoxy,

10 -NH(C<sub>1-3</sub>alkyl), and -N(C<sub>1-3</sub>alkyl)(C<sub>1-3</sub>alkyl);

R<sub>5B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

R<sub>9B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, and C<sub>1-2</sub>alkyl, and C<sub>1-2</sub>alkoxy.

63. A compound or salt according to Claim 57, wherein:

R<sub>5</sub> is selected from the group consisting of bromo, fluoro, iodo, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>3-6</sub>)alkoxy, C<sub>3-6</sub>alkyl substituted with 0-3 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-3 R<sub>6</sub>, Y, -(C=O)Y, -(CH<sub>2</sub>)Y, and -(CH(CN))Y;

R<sub>9</sub> is selected from the group consisting of halogen, cyano, -N(SO<sub>2</sub>CH<sub>3</sub>)<sub>2</sub>, -SO<sub>2</sub>NH<sub>2</sub>, halo(C<sub>1-2</sub>)alkyl, C<sub>1-3</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl);

R<sub>5B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

R<sub>9B</sub> represents 0 or 1 substituents chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, and C<sub>1-2</sub>alkyl, and C<sub>1-2</sub>alkoxy.

30 64. A compound or salt according to Claim 63, wherein:

$R_6$  is independently selected at each occurrence from the group consisting of cyano, halogen, hydroxy,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy,  $-NH(C_{1-4}\text{alkyl})$ , and  $-N(C_{1-4}\text{alkyl})(C_{1-4}\text{alkyl})$  and  $Y$ ; and

5  $Y$  is independently selected at each occurrence from  $C_{3-8}$  cycloalkyl, piperidinyl, piperazinyl, tetrahydropyranyl, dihydropyranyl, morpholinyl, thiomorpholinyl, phenyl, pyridyl, pyrazinyl, pyrimidinyl, thiazolyl, thienyl, and imidazolyl, each of which may be further substituted with  
10 one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkoxy, halo( $C_{1-4}$ )alkyl, halo( $C_{1-4}$ )alkoxy, mono- or di( $C_{1-4}$ )alkylamino, and  $C_{1-4}$ alkylthio.

65. A compound or salt according to Claim 63, wherein:

15  $R_9$  is cyano, trifluoromethyl, chloro, or iodo; and  
 $R_{9B}$  is hydrogen.

66. A compound according to Claim 50, which is  
 $N-(4\text{-tert\text{-}butylphenyl})-4-(3\text{-chloropyridin-2-yl})piperazine-1\text{-carboxamide}$ , or a pharmaceutically acceptable salt thereof.

20 67. A compound according to Claim 50, which is  $(2R)\text{-}4-(3\text{-chloropyridin-2-yl})\text{-}N-(4\text{-cyclohexylphenyl})\text{-}2\text{-methylpiperazine-1\text{-carboxamide}}$ , or a pharmaceutically acceptable salt thereof.

68. A compound according to Claim 50, which is  $(2R)\text{-}4-(3\text{-chloropyridin-2-yl})\text{-}2\text{-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1\text{-carboxamide}}$ , or a pharmaceutically acceptable salt thereof.

25 69. A compound according to Claim 50, which is  $(2R)\text{-}N-(4\text{-tert\text{-}butylphenyl})\text{-}4-(3\text{-chloropyridin-2-yl})\text{-}2\text{-methylpiperazine-1\text{-carboxamide}}$ , or a pharmaceutically acceptable salt thereof.

70. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

71. A compound according to Claim 50, which is (2S)-4-(3-chloropyridin-2-yl)-N-(4-trifluoromethylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

72. A compound according to Claim 50, which is (2S)-N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

73. A compound according to Claim 50, which is (2S)-4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

74. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-(4-piperidin-1-ylphenyl)piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

75. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[2-fluoro-4-(trifluoromethyl)phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

76. A compound according to Claim 50, which is (2R)-2-methyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

77. A compound according to Claim 50, which is (2R)-N-(4-tert-butylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

78. A compound according to Claim 50, which is (2R)-N-(4-isopropylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-

yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

79. A compound according to Claim 50, which is 4-(3-chloropyridin-2-yl)-2,6-dimethyl-N-[4-

5 (trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

80. A compound according to Claim 50, which is N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2,6-dimethylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

10 81. A compound according to Claim 50, which is 4-(3-chloropyridin-2-yl)-N-(4-isopropylphenyl)-2,6-dimethylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

15 82. A compound according to Claim 50, which is (2R)-N-(4-cyclohexylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

20 83. A compound according to Claim 50, which is 4-(3-chloropyridin-2-yl)-N-(4-cyclohexylphenyl)-2,6-dimethylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25 84. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-(4-cyclopentylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

85. A compound according to Claim 50, which is (2R)-N-(4-cyclopentylphenyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

30 86. A compound according to Claim 50, which is (2R)-N-(4-tert-butylphenyl)-4-[3-(dimethylamino)pyridin-2-yl]-2-

methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

87. A compound according to Claim 50, which is (2R)-4-[3-(dimethylamino)pyridin-2-yl]-2-methyl-N-[4-

5 (trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

88. A compound according to Claim 50, which is (2R)-N-(4-tert-  
butylphenyl)-4-(3-methoxypyridin-2-yl)-2-methylpiperazine-1-

10 carboxamide, or a pharmaceutically acceptable salt thereof.

89. A compound according to Claim 50, which is (2R)-4-(3-methoxypyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

90. A compound according to Claim 50, which is (2R)-N-(4-cyclohexylphenyl)-4-(3-methoxypyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

20

91. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[4-(3,6-dihydro-2H-pyran-4-yl)phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

92. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-(4-tetrahydro-2H-pyran-4-yl)phenyl)piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

30

93. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[4-(4-hydroxytetrahydro-2H-pyran-4-yl)phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

5

94. A compound according to Claim 50, which is (2R)-N-[4-(4-hydroxytetrahydro-2H-pyran-4-yl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

10

95. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-(2-methyl-1,3-thiazol-4-yl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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96. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[4-(2-ethyl-1,3-thiazol-4-yl)phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

20

97. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[4-(2-methoxy-1,1-dimethylethyl)phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

98. A compound according to Claim 50, which is (2R)-N-[4-(2-methoxy-1,1-dimethylethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

30

99. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[4-(1-cyano-1-methylethyl)phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

5 100. A compound according to Claim 50, which is (2R)-N-[4-(1-cyano-1-methylethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

101. A compound according to Claim 50, which is N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2-ethylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

102. A compound according to Claim 50, which is 4-(3-chloropyridin-2-yl)-2-ethyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

103. A compound according to Claim 50, which is 4-(3-chloropyridin-2-yl)-2-ethyl-N-(4-isopropylphenyl)piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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104. A compound according to Claim 50, which is N-(4-tert-butylphenyl)-2-ethyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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105. A compound according to Claim 50, which is 2-ethyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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106. A compound according to Claim 50, which is 2-ethyl-N-(4-isopropylphenyl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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107. A compound according to Claim 50, which is 2-tert-butyl-N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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108. A compound according to Claim 50, which is 2-tert-butyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

15

109. A compound according to Claim 50, which is N-(4-tert-butylphenyl)-4-(3-chloropyridin-2-yl)-2-isopropylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

20

110. A compound according to Claim 50, which is N-(4-tert-butylphenyl)-2-isopropyl-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

111. A compound according to Claim 50, which is 2-isopropyl-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

30

112. A compound according to Claim 50, which is 2-isopropyl-N-(4-isopropylphenyl)-4-[3-(trifluoromethyl)pyridin-

2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

113. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

114. A compound according to Claim 50, which is (2R)-N-(4-tert-butylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

115. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

116. A compound according to Claim 50, which is (2R)-N-(4-cyclohexylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

117. A compound according to Claim 50, which is (2R)-N-(4-cyclopentylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

118. A compound according to Claim 50, which is (2R)-N-(4-tert-butylphenyl)-4-(3-cyanopyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

119. A compound according to Claim 50, which is (2R)-4-(3-cyanopyridin-2-yl)-2-methyl-N-[4-

(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

120. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-{4-[cyano(phenyl)methyl]phenyl}-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

121. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[3-methyl-4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

122. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[3-methyl-4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

123. A compound according to Claim 50, which is (2R)-4-[3-[bis(methylsulfonyl)amino]pyridin-2-yl]-N-(4-tert-butylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

124. A compound according to Claim 50, which is (2R)-2-methyl-N-[3-methyl-4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl] piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

125. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-{4-[1-

(trifluoromethyl)vinyl]phenyl} piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

126. A compound according to Claim 50, which is (2R)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-yl]-N-[4-[1-(trifluoromethyl)vinyl] phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

127. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[4-[1-(trifluoromethyl)vinyl] phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

128. A compound according to Claim 50, which is (2R)-N-(4-sec-butylphenyl)-4-(3-fluoropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

129. A compound according to Claim 50, which is (2R)-2-methyl-N-[4-(2,2,2-trifluoro-1-methylethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

130. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-[4-(2,2,2-trifluoro-1-methylethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

131. A compound according to Claim 50, which is (2R)-4-(3-chloro-5-nitropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

132. A compound according to Claim 50, which is (2R)-4-(5-amino-3-chloropyridin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a 5 pharmaceutically acceptable salt thereof.

133. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-N-[3-fluoro-4-(trifluoromethyl) phenyl]-2-methylpiperazine-1-carboxamide, or a 10 pharmaceutically acceptable salt thereof.

134. A compound according to Claim 50, which is (2R)-N-[3-fluoro-4-(trifluoromethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl) pyridin-2-yl]piperazine-1-carboxamide, or a 15 pharmaceutically acceptable salt thereof.

135. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-(2,2,2-trifluoro-1-methylethyl)phenyl]piperazine-1-carboxamide, or a 20 pharmaceutically acceptable salt thereof.

136. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-(2,2,4,4-tetrafluoro-4H-1,3-benzodioxin-6-yl)piperazine-1-carboxamide, or a 25 pharmaceutically acceptable salt thereof.

137. A compound according to Claim 50, which is (2R)-4-(3-fluoropyridin-2-yl)-2-methyl-N-(2,2,4,4-tetrafluoro-4H-1,3-benzodioxin-6-yl)piperazine-1-carboxamide, or a 30 pharmaceutically acceptable salt thereof.

138. A compound according to Claim 50, which is (2R)-2-methyl-N-(2,2,4,4-tetrafluoro-4H-1,3-benzodioxin-6-yl)-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

5

139. A compound according to Claim 50, which is (2R)-4-[3-(aminosulfonyl)pyridin-2-yl]-N-(4-tert-butylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

10

140. A compound according to Claim 50, which is (2R)-N-(4-benzoylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof. . . .

15

141. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-(4-iodophenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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142. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-[4-[2,2,2-trifluoro-1,1-bis(trifluoromethyl)ethyl]phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

143. A compound according to Claim 50, which is (2R)-2-methyl-N-[4-[2,2,2-trifluoro-1,1-bis(trifluoromethyl)ethyl]phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

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144. A compound according to Claim 50, which is (2R)-N-(4-butylphenyl)-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

145. A compound according to Claim 50, which is 2-(fluoromethyl)-N-[4-(trifluoromethyl)phenyl]-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

5

146. A compound according to Claim 50, which is (2R)-N-[4-bromo-3-(trifluoromethyl)phenyl]-4-(3-chloropyridin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

10

147. A compound according to Claim 50, which is (2R)-N-[4-bromo-3-(trifluoromethyl)phenyl]-2-methyl-4-[3-(trifluoromethyl) pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

15

148. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-N-[4-fluoro-3-(trifluoromethyl) phenyl]-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

20

149. A compound according to Claim 50, which is (2R)-N-[4-fluoro-3-(trifluoromethyl) phenyl]-2-methyl-4-[3-(trifluoromethyl) pyridin-2-yl] piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

150. A compound according to Claim 50, which is (2R)-4-(3-chloropyridin-2-yl)-2-methyl-N-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl] phenyl}piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

30

151. A compound according to Claim 50, which is (2R)-2-methyl-N-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl}-4-[3-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

5

152. A compound according to Claim 40, which is (2R)-N-(4-tert-butylphenyl)-4-(3-chloropyrazin-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

10

153. A compound according to Claim 40, which is (2R)-4-(3-chloropyrazin-2-yl)-N-(4-isopropylphenyl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

15

154. A compound according to Claim 40, which is (2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

20

155. A compound according to Claim 40, which is (2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl] phenyl} piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

156. A compound according to Claim 40, which is (2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-{4-cyclopentyl-phenyl} piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

30

157. A compound according to Claim 40, which is (2R)-4-(3-chloropyrazin-2-yl)-2-methyl-N-{4-cyclohexyl-phenyl}

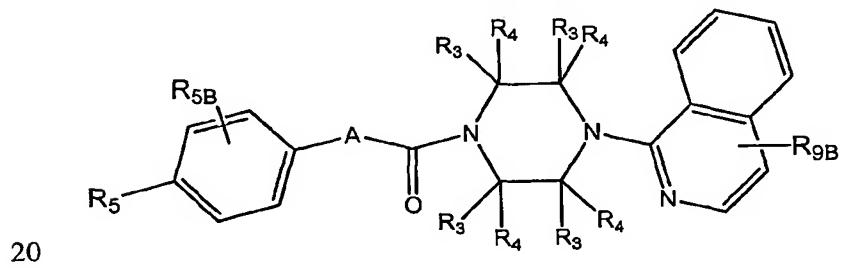
piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

158. A compound according to Claim 42, which is 4-(3-5 chloropyridin-2-yl)-N-[5-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

159. A compound according to Claim 42, which is (2R)-4-(3-10 chloropyridin-2-yl)-2-methyl-N-[5-(trifluoromethyl)pyridin-2-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

160. A compound according to Claim 42, which is (2R)-4-(3-15 chloropyridin-2-yl)-2-methyl-N-[6-(trifluoromethyl)pyridin-3-yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

161. A compound of the Formula:



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or a pharmaceutically acceptable salt thereof, wherein:

A is absent or is selected from the group consisting of O, S, NR<sub>A</sub>, CR<sub>B</sub>R<sub>B</sub>', NR<sub>A</sub>CR<sub>B</sub>R<sub>B</sub>', CR<sub>B</sub> R<sub>B</sub>'NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where

25 R<sub>A</sub>, R<sub>B</sub>, and R<sub>B</sub>' are independently selected at each occurrence from hydrogen or C<sub>1-6</sub> alkyl;

R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl);

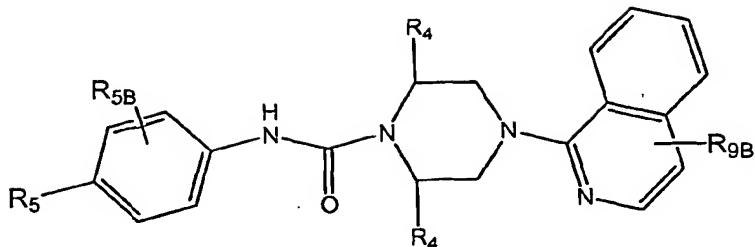
R<sub>5</sub> is selected from the group consisting of halogen, halo(C<sub>1-6</sub>)alkyl, C<sub>3-6</sub>alkyl substituted with 0-3 R<sub>6</sub>, C<sub>2-6</sub>alkenyl substituted with 0-3 R<sub>6</sub>, (C<sub>3-8</sub>cycloalkyl)C<sub>1-4</sub>alkyl substituted with 0-3 R<sub>6</sub>, and Y;

R<sub>5B</sub> and R<sub>9B</sub> each represent from 0 to 2 substituents and are independently chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy;

R<sub>6</sub> is independently selected at each occurrence from the group consisting of cyano, halogen, hydroxy, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, -NH(C<sub>1-4</sub>alkyl), and -N(C<sub>1-4</sub>alkyl)(C<sub>1-4</sub>alkyl) and Y;

Y is independently selected at each occurrence from C<sub>3-8</sub>cycloalkyl, piperidinyl, piperazinyl, tetrahydropyranyl, dihydropyranyl, morpholinyl, thiomorpholinyl, phenyl, pyridyl, pyrazinyl, pyrimidinyl, thiazolyl, thienyl, and imidazolyl, each of which may be further substituted with one or more substituents independently selected from halogen, oxo, hydroxy, amino, nitro, cyano, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, halo(C<sub>1-4</sub>)alkyl, halo(C<sub>1-4</sub>)alkoxy, mono- or di(C<sub>1-4</sub>)alkylamino, and C<sub>1-4</sub>alkylthio.

162. A compound or salt according to Claim 161 of the Formula:



wherein

R<sub>4</sub> is independently selected at each occurrence from hydrogen and C<sub>1-4</sub>alkyl.

5

163. A compound or salt according to Claim 162, wherein: R<sub>5</sub> is selected from the group consisting of halo(C<sub>1-6</sub>)alkyl, C<sub>3</sub>-alkyl, (C<sub>3-8</sub>cycloalkyl)C<sub>1-4</sub>alkyl, and Y;

R<sub>5B</sub> and R<sub>9B</sub> each represent from 0 to 1 substituents and are independently chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy;

Y is selected from C<sub>3-8</sub> cycloalkyl, piperidinyl, piperazinyl, tetrahydropyranyl, dihydopyranyl, morpholinyl, thiomorpholinyl, phenyl, pyridyl, pyrazinyl, pyrimidinyl, thiazolyl, thienyl, and imidazolyl.

164. A compound according to Claim 161, which is (2R)-4-isoquinolin-1-yl-2-methyl-N-[4-(trifluoromethyl)phenyl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

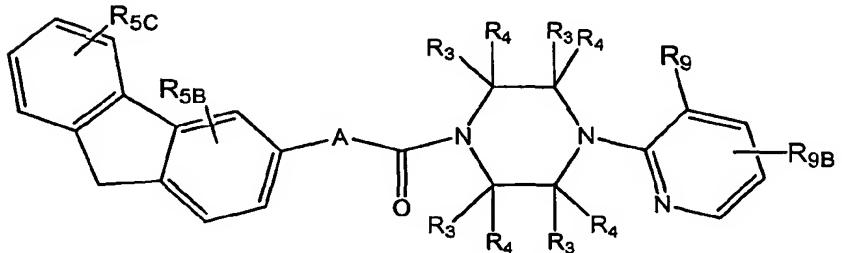
165. A compound according to Claim 161, which is (2R)-N-(4-tert-butylphenyl)-4-isquinolin-1-yl-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

166. A compound according to Claim 161, which is (2R)-N-(4-isopropylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

5 167. A compound according to Claim 161, which is (2R)-N-(4-cyclopentylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

10 168. A compound according to Claim 161, which is (2R)-N-(4-cyclohexylphenyl)-4-isoquinolin-1-yl-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

169. A compound of the Formula:



15

or a pharmaceutically acceptable salt thereof, wherein:

A is absent or is selected from the group consisting of O, S, NR<sub>A</sub>, CR<sub>B</sub>R<sub>B</sub>', NR<sub>A</sub>CR<sub>B</sub>R<sub>B</sub>', CR<sub>B</sub>R<sub>B</sub>'NR<sub>A</sub>, -CR<sub>A</sub>=CR<sub>B</sub>-, and C<sub>3</sub>H<sub>4</sub>; where R<sub>A</sub>, R<sub>B</sub>, and R<sub>B</sub>' are independently selected at each occurrence from hydrogen or C<sub>1-6</sub> alkyl;

20 R<sub>3</sub> and R<sub>4</sub> are independently chosen at each occurrence from the group consisting of hydrogen, halogen, cyano, nitro, halo(C<sub>1-6</sub>)alkyl, halo(C<sub>1-6</sub>)alkoxy, hydroxy, amino, C<sub>1-6</sub>alkyl, C<sub>2-6</sub>alkenyl, C<sub>2-6</sub>alkynyl, C<sub>1-6</sub>alkoxy, -NH(C<sub>1-6</sub>alkyl), and -N(C<sub>1-6</sub>alkyl)(C<sub>1-6</sub>alkyl);

25 R<sub>5B</sub>, R<sub>5C</sub>, and R<sub>9B</sub> each represent from 0 to 2 substituents and are independently chosen from halogen, cyano, nitro,

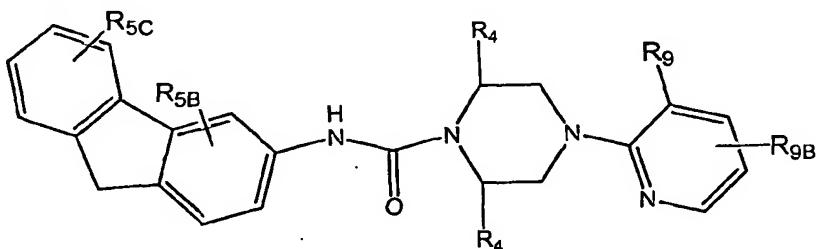
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halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

R<sub>9</sub> is selected from the group consisting of halogen, cyano, -N(SO<sub>2</sub>CH<sub>3</sub>)<sub>2</sub>, -SO<sub>2</sub>NH<sub>2</sub>, halo(C<sub>1-3</sub>)alkyl, C<sub>1-3</sub>alkoxy, 5 -NH(C<sub>1-3</sub>alkyl), and -N(C<sub>1-3</sub>alkyl)(C<sub>1-3</sub>alkyl)

170. A compound or salt according to Claim 169 of the

Formula:



10 wherein

R<sub>4</sub> is independently selected at each occurrence from hydrogen and C<sub>1-4</sub>alkyl.

171. A compound or salt according to Claim 170, wherein:

15 R<sub>9</sub> is selected from the group consisting of halogen and halo(C<sub>1-2</sub>)alkyl; and

R<sub>5B</sub> and R<sub>9B</sub> each represent from 0 to 1 substituents and are independently chosen from halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy.

172. A compound according to Claim 169, which is (2R)-4-(3-chloropyridin-2-yl)-N-(9H-fluoren-2-yl)-2-methylpiperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

25

173. A compound according to Claim 169, which is (2R)-N-(9H-fluoren-2-yl)-2-methyl-4-[3-(trifluoromethyl) pyridin-2-

yl]piperazine-1-carboxamide, or a pharmaceutically acceptable salt thereof.

174. A compound according to Claim 38, which is (2R)-N-(4-  
5 tert-butylcyclohexyl)-4-(3-chloropyridin-2-yl)-2-  
methylpiperazine-1-carboxamide, or a pharmaceutically  
acceptable salt thereof.

175. A compound according to Claim 38, which is (2R)-4-(3-  
10 chloropyridin-2-yl)-N-(4-isopropylcyclohexyl)-2-  
methylpiperazine-1-carboxamide, or a pharmaceutically  
acceptable salt thereof.

176. A compound according to Claim 38, which is (2R)-N-(4-  
15 isopropylcyclohexyl)-2-methyl-4-[3-(trifluoromethyl)pyridin-2-  
yl]piperazine-1-carboxamide, or a pharmaceutically acceptable  
salt thereof.

177. A method of reducing the calcium conductance of  
20 a capsaicin receptor, which method comprises: contacting a  
first solution comprising a fixed concentration of a  
capsaicin receptor agonist and a compound or salt of Claim 50  
with a cell expressing the capsaicin receptor, wherein the  
compound or salt is present in the solution at a concentration  
25 sufficient to produce a detectable reduction of the calcium  
mobilization effects of the capsaicin receptor agonist when  
tested in an *in vitro* assay in which cells expressing a  
capsaicin receptor are contacted with a second solution  
comprising the fixed concentration of capsaicin receptor  
30 agonist and the compound or salt.

178. The method of Claim 177 wherein the cell expressing the capsaicin receptor is a neuronal cell that is contacted *in vivo* in an animal, and wherein the first solution is a body fluid of said animal.

5

179. The method of Claim 177 wherein the animal is a human patient.

180. A pharmaceutical composition comprising a 10 pharmaceutically acceptable carrier and a compound or salt of Claim 50.

181. A package comprising a pharmaceutical composition of claim 180 in a container and further comprising indicia 15 comprising instructions for using the composition to alleviate pain.

182. A package comprising a pharmaceutical composition of claim 180 in a container and further comprising indicia 20 comprising instructions for using the composition to treat a patient suffering from urinary incontinence.

183. A package comprising a pharmaceutical composition of claim 180 in a container and further comprising indicia 25 comprising instructions for using the composition to alleviate symptoms of exposure to capsaicin or tear gas.

184. A compound or salt of Claim 50 wherein, in an *in vitro* assay of capsaicin receptor antagonism, the compound or salt 30 exhibits capsaicin receptor antagonist activity, but in an *in*

*vitro* assay of capsaicin receptor agonism the compound does not exhibit detectable agonist activity.

185. A compound or salt of Claim 50 wherein a dose of the  
5 compound or salt that is twice the minimum dose sufficient to provide analgesia in an animal model for determining pain relief does not produce sedation in an animal model assay of sedation.

10 186. A method of treating a mammal suffering from at least one symptom selected from the group consisting of symptoms of exposure to capsaicin, symptoms of burns or irritation due to exposure to heat, symptoms of burns or irritation due to exposure to light, symptoms of burns, bronchoconstriction or  
15 irritation due to exposure to tear gas, and symptoms of burns or irritation due to exposure to acid, the method comprising administering to the mammal a therapeutic dose of a compound that is a high potency capsaicin receptor antagonist in an *in vitro* assay of capsaicin receptor antagonism, is not a  
20 capsaicin analog; wherein the therapeutic dose contains an amount of the compound that is effective to reduce severity of at least one of said at least one symptom.

187. The method of claim 186 wherein the compound is a  
25 compound or salt of any of claims 1-176.

188. A method of treating a mammal suffering from neuropathic pain, the method comprising administering to the mammal a therapeutically effective amount of a compound that is  
30 a high potency capsaicin receptor antagonist in an *in vitro* assay of capsaicin receptor antagonism.

189. A method of treating a mammal suffering from peripheral-nerve-mediated pain, the method comprising administering to the mammal a therapeutic dose of a compound 5 that is a capsaicin receptor antagonist, wherein the compound is a high potency capsaicin receptor antagonist in an *in vitro* assay of capsaicin receptor antagonism and is not a capsaicin analog,

wherein the therapeutic dose contains an amount of the 10 compound that is effective to reduce the peripheral-nerve-mediated pain.

190. The method of Claim 189 wherein the compound is a compound or salt of Claim 50.

191. The method of claim 189 wherein the pain is 15 neuropathic pain.

192. The method of Claim 190 wherein the pain is associated 20 with a condition selected from the group consisting of postmastectomy pain syndrome, stump pain, phantom limb pain, oral neuropathic pain, Charcot's pain, toothache, venomous snake bite, spider bite, insect sting, postherpetic neuralgia, diabetic neuropathy, reflex sympathetic dystrophy, trigeminal neuralgia, osteoarthritis, rheumatoid arthritis, fibromyalgia, 25 Guillain-Barre syndrome, meralgia paresthetica, burning-mouth syndrome, bilateral peripheral neuropathy, causalgia, sciatic neuritis, peripheral neuritis, polyneuritis, optic neuritis, postfebrile neuritis, migrating neuritis, segmental neuritis, 30 Gombault's neuritis, neuronitis, cervicobrachial neuralgia, cranial neuralgia, geniculate neuralgia, glossopharyngial

neuralgia, migranous neuralgia, idiopathic neuralgia, intercostals neuralgia, mammary neuralgia, mandibular joint neuralgia, Morton's neuralgia, nasociliary neuralgia, occipital neuralgia, red neuralgia, Sluder's neuralgia, splenopalatine neuralgia, supraorbital neuralgia, vidian neuralgia, sinus headache, tension headache, labor, childbirth, intestinal gas, menstruation, cancer, and trauma.

193. A compound or salt of Claim 50 wherein the compound or  
10 salt is not addictive.

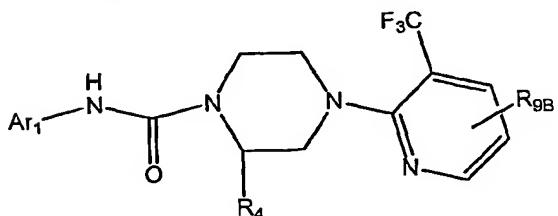
194. The use of a compound according to Claim 1, 4, 9, 31, or 50 for the manufacture of a medicament for the treatment of pain.

15 195. The use of a compound according to Claim 1, 4, 9, 31, or 50 for the manufacture of a medicament for the treatment of neuropathic pain.

20 196. The use of a compound according to Claim 1, 4, 9, 31, or 50 for the manufacture of a medicament for the treatment of the pain associated with a condition selected from the group consisting of postmastectomy pain syndrome, stump pain, phantom limb pain, oral neuropathic pain, Charcot's pain, toothache, 25 venomous snake bite, spider bite, insect sting, postherpetic neuralgia, diabetic neuropathy, reflex sympathetic dystrophy, trigeminal neuralgia, osteoarthritis, rheumatoid arthritis, fibromyalgia, Guillain-Barre syndrome, meralgia paresthetica, burning-mouth syndrome, bilateral peripheral neuropathy, 30 causalgia, sciatic neuritis, peripheral neuritis, polyneuritis, optic neuritis, postfebrile neuritis, migrating neuritis,

segmental neuritis, Gombault's neuritis, neuronitis, cervicobrachial neuralgia, cranial neuralgia, geniculate neuralgia, glossopharyngial neuralgia, migranous neuralgia, idiopathic neuralgia, intercostals neuralgia, mammary neuralgia, mandibular joint neuralgia, Morton's neuralgia, nasociliary neuralgia, occipital neuralgia, red neuralgia, Sluder's neuralgia, splenopalatine neuralgia, supraorbital neuralgia, vidian neuralgia, sinus headache, tension headache, labor, childbirth, intestinal gas, menstruation, cancer, and 10 trauma.

197. A compound of the Formula



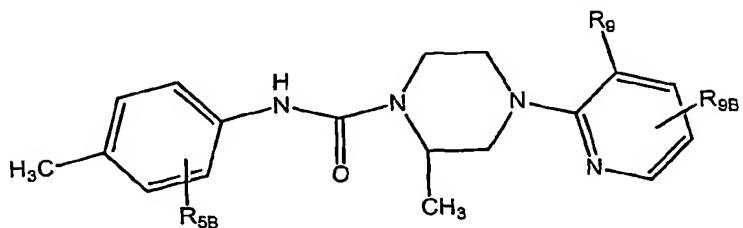
15 or a pharmaceutically acceptable salt thereof wherein:

R<sub>4</sub> is methyl or hydrogen;

R<sub>9B</sub> represents 0-2 substituents independently chosen from: halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl, halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy; and

20 Ar<sub>1</sub> is 2,4-dichlorophenyl or 3-nitro-4-chlorophenyl.

198. A compound of the Formula



or a pharmaceutically acceptable salt thereof wherein:  
R<sub>9</sub> is chloro or trifluoromethyl; and  
R<sub>5B</sub> and R<sub>9B</sub> independently represent from 0-2 substituents on each  
of the rings on which they occur and are independently  
5 chosen from: halogen, cyano, nitro, halo(C<sub>1-2</sub>)alkyl,  
halo(C<sub>1-2</sub>)alkoxy, amino, C<sub>1-4</sub>alkyl, and C<sub>1-2</sub>alkoxy.

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208

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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(54) Title: CAPSAICIN RECEPTOR LIGANDS

(57) Abstract: Disclosed are diaryl piperazines and related compounds. These compounds are selective modulators of capsaicin receptors, including human capsaicin receptors, that are, therefore, useful in the treatment of a chronic and acute pain conditions, itch and urinary incontinence. Methods of treatment of such disorders and well as packaged pharmaceutical compositions are also provided. Compounds of the invention are also useful as probes for the localization of capsaicin receptors and as standards in assays for capsaicin receptor binding and capsaicin receptor mediated cation conductance. Methods of using the compounds in receptor localization studies are given.

## INTERNATIONAL SEARCH REPORT

International Application No
PC1/US 01/22930

A. CLASSIFICATION OF SUBJECT MATTER					
IPC 7	C07D213/74	C07D401/04	C07D295/192	C07D295/21	C07D295/215
	C07D241/20	C07D403/04	C07D405/12	C07D417/12	C07D217/22
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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, CHEM ABS Data, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 021 438 A (JUNGE BODO ET AL) 4 June 1991 (1991-06-04)  column 22, lines 15-20; column 23, lines 45-50; column 27, lines 18-20 ---	1,180, 189, 194-196
X	EP 0 790 240 A (TANABE SEIYAKU CO) 20 August 1997 (1997-08-20)  table 15, example 127; example 189; table 24, examples 199, 206, 209, 211-214, 217-219, 233-240, 243-247, 252, 253 page 79, line 17 - line 22; claim 1 --- -/-	1-7, 9, 11-15, 31-37, 180

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A61P25/06

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Further documents are listed in the continuation of box C.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/22930

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 64394 A (STAMFORD ANDREW W; DUGAR SUNDEEP (US); SCHERING CORP (US); WU YUSH) 16 December 1999 (1999-12-16) page 32, examples 8B and 8D ---	4-7, 27-29, 31,180
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A	US 5 840 720 A (CHEN ING-JUN) 24 November 1998 (1998-11-24) abstract -----	177, 186-192

FURTHER INFORMATION CONTINUED FROM PCT/USA/ 210

Continuation of Box I.2

Claims Nos.: 186, 188, 189 (all partly)

Present claims 186, 188, 189 relate to a compound defined by reference to a desirable characteristic or property, namely that it is a high potency capsaicin receptor antagonist in an in vitro assay of capsaicin receptor antagonism (claims 186, 188, 189) and that it is not a capsaicin analog (claims 186, 189).

The claims cover all compounds having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and/or disclosure within the meaning of Article 5 PCT for only a limited number of such compounds. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the compounds by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to the methods making use of compounds mentioned in claim 187, i.e. compounds covered by claims 1-176 and by the concrete examples given in the description (with regard to claims 186 and 188), and to the methods making use of compounds mentioned in claim 190, i.e. compounds covered by claim 50 and by the examples given in the description (with regard to claim 189).

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

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Information on patent family members

International Application No

PCT/US 01/22930

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